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| 1882 | " | 45 | " " | 1889 | " | 234 | " " |
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| 1884 | " | 82 | " " | 1891 | " | 325 | " " |
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CONTENTS.

EDITORIAL: PAGE

Paragraphs ..... 219

ILLUSTRATED ARTICLES:

Electrical World Portraits—XXXV.—Prof. Elisha Gray. ..... 220
The Telautograph ..... 220
Theory of the Transformer, by F. Bedell and A. C. Crehore.... 223
Conductors and Insulators—III., by Reginald A. Fessenden.... 224
The Design of a Central Station for Incandescent Electric Lights—II., by E. P. Roberts ..... 225
Suggestions for Metering Devices—V., by S. D. Mott..... 228
Single Phase Alternating Motors, by Elihu Thomson..... 228
The Diffusion of Light—II., by W. E. Sumpner..... 228
A Modern Central Station..... 229
The Electrical World's Digest of Current Technical Electrical Literature..... 230
The Malden Electric Company's Plant..... 233
An Electric Light Problem..... 234
The Wattles Gas Engine..... 234
New Queen Measuring Instruments..... 235
The Pryibil Friction Clutch Pulley and Loose Pulley Hanger.. 235
A Portable Electric Combination Bell ..... 225
The Paradox Flexible Shade..... 236
The Pass & Seymour Three-Wire Switch..... 236

MISCELLANEOUS:

The Incandescent Lamp Situation..... 222
Electric Tanning..... 223
Unjust Law, by A. B. Upham..... 233
New Books ..... 233
Institution of Electrical Engineers—IV., Inaugural Address of W. H. Preece..... 234

FINANCIAL INTELLIGENCE: The Electrical Stock Market, 236; New Incorporations, 236.

SPECIAL CORRESPONDENCE: New York Notes, 237; Philadelphia Notes, 237; New England Notes, 237; Western Notes, 237; Canadian Notes, 238; English Notes, 238.

NEWS OF THE WEEK: The Electric Light, 239; The Electric Railway, 239; Miscellaneous, 239; Legal Notes, 239.

INDUSTRIAL AND TRADE NOTES..... 239

BUSINESS NOTICES..... 240

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS..... 240

**The Lamp Situation.** IN order to give all parties interested an opportunity of discussing this very important subject, THE ELECTRICAL WORLD has invited a number of the most prominent to express their views Some of the answers to this invitation appear in this issue, and others will be published from time to time as they are received. While special invitations were extended to a few to take part in this discussion, we desire it understood that the invitation thus extended is not limited to those few, but is equally extended to others who by reason of their relations to the interests involved are so situated as to be able to discuss the matter intelligently. The moderate tone which characterizes the letters already received bespeaks the good judgment of those who have responded, for it is apparent that nothing is to be gained by intemperate ravings such as have brought notoriety to one of our contemporaries.

**The Theory of the Transformer.** THE study of the phenomena of alternating currents has become one of the most fascinating in the domain of electrical science, and will probably result in the future, as it has in the past, in some of our most important advances. Unfortunately for the masses, the subject has heretofore been so hedged about by technicalities as to be within the ken of but a comparatively limited few. Every advance, therefore, in simplifying this study should be welcomed by the fraternity at large. The latest contribution in this direction is from the pens of Drs. Bedell and Crehore, commenced in this issue. In these papers the theory of the transformer will be developed by easy stages from the more elementary principles, so that the novice will be introduced to the more abstract discussions without too great a strain upon his intellectual capital. The greatest advances may be looked for through the popularization of science, and we expect that this present attempt will meet its well merited success.

**Non-Conductors and Insulators.** SIMULTANEOUSLY with the appearance of Mr. Fessenden's first number on conductors and insulators, we editorially called attention to the unusual standpoint from which the subject is being treated, and predicted for the series of articles an interest which does not attach to the usual method of handling this subject. Mr. Fessenden writes as a student of molecular physics, and as such considers the phenomena with which he deals as directly dependent upon the ether, which, as Lord Kelvin and others are inclined to believe, is the fountain head of all our physical phenomena. In fact, the tendency of all modern thought is toward this view, and if this be correct, as there appears to be every reason to suppose, Mr. Fessenden is discussing his subject from the very foundation stone of the structure. The number which appears in this issue fully fulfills the expectations held out by those which preceded, and while the methods involved are probably too technical for many of our readers to follow, those who are interested in molecular physics will find them intensely interesting as well as instructive.

**Another Cause for Mutual and Self-Gratulation.** WE have in recent numbers taken occasion to felicitate ourselves and our friends upon the prosperous condition of THE ELECTRICAL WORLD as evidenced by its large and rapidly increasing circulation, the extensive use made by our patrons of its advertising columns, and the dignified course which we have been able to maintain under slanderous attacks from envious contemporaries and under more trying conditions of trade than the electrical interests have ever before been called upon to meet. We now wish to call attention to another evidence of the approval with which THE ELECTRICAL WORLD is received by the makers of electrical science in the fact that it is conceded by them as the best medium through which to make known their new thoughts and the most recent results of their labor. Although THE ELECTRICAL WORLD is issued as a sixteen page journal, and these by far the largest of any in the field, so great has been the demand on our space that since the beginning of the year but on two occasions have the sixteen pages proved sufficient for the material in hand, and on all other occasions their number has had to be increased, usually to 20 pages—in one case to 30—and in this issue to 22 pages.

**The Telautograph Exhibition.** CONSIDERABLE space is given this week to a description of the construction and working of the telautograph, the latest invention of Prof. Elisha Gray, which will doubtless attract the attention of the reading public. The reproductions given in illustration of the working of this device are from samples of the work performed by the commercial machine as now constructed and ready for public use. The diagram is reproduced from the patent specification of Prof. Gray, and it is believed with the assistance of the descriptive matter the *modus operandi* of transmitting autographic symbols in fac-simile will be readily understood by even the non-technical. There is a prevalent belief among laymen in the tendency of science toward complication, but it will be seen, from the description here given of the telautograph, how an elementary knowledge of the science of mechanics enables us to resolve the most complex motions imaginable into two or more rectilinear motions acting at an angle with each other. Without this simplification the transmission of the complex curves of an autograph would have probably remained an impossibility, or have involved such complicated apparatus as to render its accomplishment an impossibility. The thought of the transmission of written language naturally causes one's mind to revert to the transmission of the spoken language, and the evolution of both operations has involved not dissimilar steps. While the transmission of musical notes had been accomplished long before the advent of the telephone, and the character of the vibrations necessary therefor was well understood, it was still believed that the vibrations involved in articulate speech were of such a complex nature as to possibly forever stand as a bar to their artifical reproduction. Yet with the discovery of the phonograph they were found so simple that the student of acoustics wondered not at the accomplishment of the feat, but that it had not been accomplished long before. In fact we remember when the phonograph was first exhibited it gave to our minds a new meaning to the words of the textbooks on acoustics, which enabled us to read between the lines in books published many years before almost explicit directions how to accomplish the hitherto unheard of feat of registering for future reproduction not only the tones but the characteristics of articulate speech. But the success of the phonograph depended largely upon details which had to be worked out carefully before its value could become apparent. So it is in the transmission and reproduction of written language. At first sight we are appalled at the complexity of the factors involved, which deterred many at first from attempting the solution of the problem. An elementary knowledge of the laws of mechanics so simplified the underlying principles, however, as to make the problem seem easy of accomplishment, but here again success was only obtainable by the laborious working out of the minute details, and it is this work which Prof. Gray had set himself to do which has given us to-day the remarkable instrument and process founded upon such simple principles and laws.

**Prof. Elisha Gray.** WE give in this issue a reproduction of a recent photograph of Prof. Elisha Gray, together with a short sketch of his career, which we know will be found interesting by our many readers. Prof. Gray occupies a position in electrical history which is somewhat unique in that, although he has reached middle life, he is still among the foremost of the developers of that science. It is indeed remarkable that this sentence can be written in regard to the science of electricity, but it is a fact that has been noted on all sides that the prominent workers in electricity are, as a rule, young men. In other sciences it has almost as generally been the case that the new advances and discoveries of greatest importance were the result of mature years and ripened experience. But for some reason or other the important steps in electrics have largely been taken by young men who have come into the field within the last ten years. As before intimated, Prof. Gray has been an exception to this general rule in that he has been prominent from a time antedating the birth of many of his fellow-workers, and with each step in advance has added to the lustre of his name. His invention of the speaking telephone, from the enjoyment of the benefits from which he has been debarred, is another illustration of the contemporaneous and independent inception of a great invention by two minds working in the same direction from somewhat different standpoints. His latest invention, which is now first brought authoritatively before the public, would seem to follow from the telephone as a natural sequence, although when the details of the two are more closely considered it will be seen how widely they differ the one from the other. It is not possible at this time to foresee how widely the telautograph will find application in the routine of our daily lives, for the success of inventions seems to follow nowhere defined laws, but rather, in some cases, seems to be the result of caprice or fortuitous circumstances. Thus, while in the abstract the telephone was at once recognized as a most important advance, it was looked upon, at its birth, by practical men as but an interesting toy. Still other inventions which have given less promise on their first introduction have proved of inestimable value after the lapse of time, while the reverse has been true of still others that could be mentioned. A gentleman well known in electrical circles, who has invested very extensively in patents of various kinds, once said to the writer that he considered the talent which was necessary to properly handle a meritorious invention was fully the equal of that required to originate the invention itself. It is undoubtedly true that the success to be reached is due very largely to the business sagacity with which an invention is managed, and that many really very meritorious inventions have come little into practical use through the mistakes of those in whose hands they were placed. Notwithstanding the merits of the telephone, whose use is now so universal, and so essential to the transaction of business, it is doubtful if it would have been much known to-day had it fallen into inefficient hands. So we regard the telautograph. It is an invention of intrinsic merit, but its commercial success will depend in a great measure upon its management in the future. We are glad to say that in this respect it seems to be as fortunate in falling into the present hands as the idea was in falling into those of Prof. Gray, who has so successfully developed it into a practical machine.

## ELECTRICAL WORLD PORTRAITS.—NO. XXXV.

PROF. ELISHA GRAY.

The subject of this sketch, an excellent recent portrait of whom is given, is a man whose works have made an impression upon the electrical science of the present day scarcely less important than that of any other whose name might be mentioned. Born at Barnesville, Bellmont county, O., on Aug. 2, 1835, he is now therefore in his 57th year.

It has often been said that those who have contributed to the electrical progress of the present day are invariably young men. Prof. Gray stands as an illustrious example of an exception to this general rule, for, though while not yet an old man, he is one of the few who, prominent in the early days of electrical development, have maintained their prominence and added to their reputations in the rapid strides which have been made during the last decade.

The fact that few of the earlier workers in electrical science have maintained their prominence in the later developments is probably due to the lack of plasticity which is usually attributed to maturer years, the possession of which in younger men has given them an advantage in the rush for supremacy in new adaptations.

Where, however, this plasticity has been preserved during maturer years, as has been the case with the subject of this sketch, the maturer judgment and riper experience which those years have enabled them to bring to bear upon the newer problems have in many cases resulted in inventions of the utmost importance to mankind and to the cause of civilization.

Among the notable instances of exceptions of this kind may be mentioned Sir William Thomson, Prof. Helmholtz, Werner von Siemens, and our own Prof. A. E. Dolbear and Prof. Elisha Gray. In early life the latter was a carpenter's apprentice, and it is related of him at this time that he was a social nuisance, because of his proclivity to acids and laboratory stuffs. At 21 he went to Oberlin College, where he studied for five years, most of his attention being devoted to natural philosophy.

It was not until his 30th year, however, that his attention was first turned to electrical mechanisms, with which he soon became fascinated, and to which thereafter he devoted most of his time and study. The bent of his mind soon led him to invention, the first recorded attempt at which consisted of an automatic self-adjusting relay. This, while successful in accomplishing what was intended, never came into general use, but has formed the basis for other inventions whose importance is now universally recognized.

His first invention of practical importance was that of the needle annunciator for hotels; this he invented in 1870 and perfected it in 1872. The electrical annunciator for elevators was also invented at about the same time.

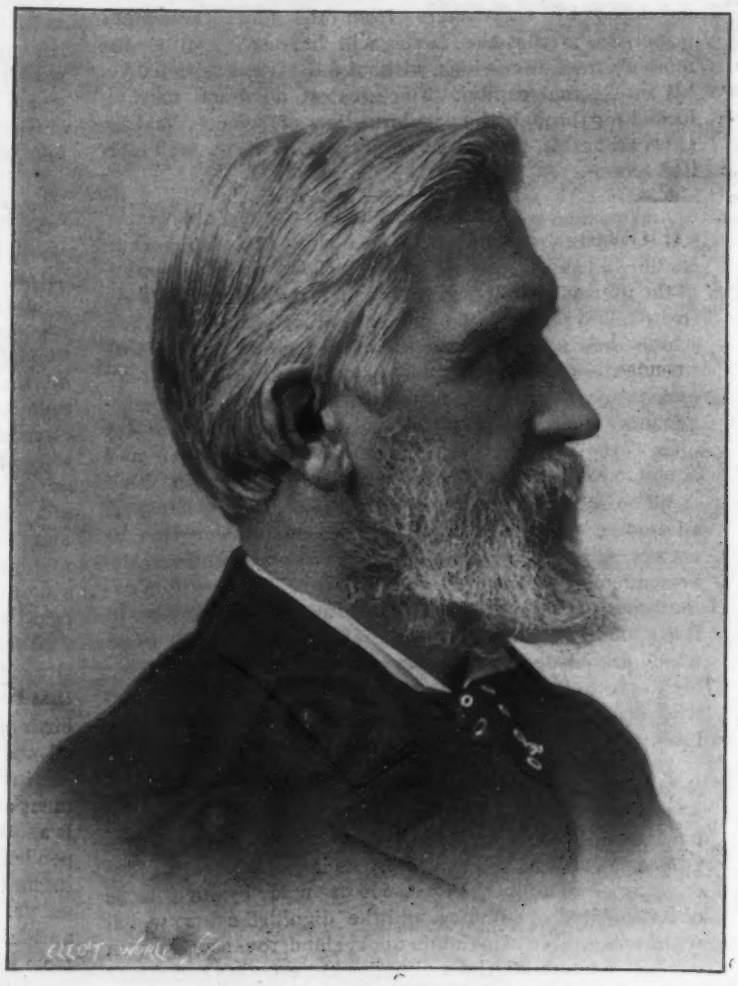
Still more important than these, and following them in point of time, was his private telegraph line printer, so well known to this day. During the years 1873-4-5 his attention was largely absorbed in developing a system of electro-harmonic telegraphy for the transmission of sounds over the wires of the telegraph. The basis of this system is the discovery of the law of vibration by which a sound produced in the presence of a magnet will cause a magnet of similar adjustment to respond to its tone. The discovery that another note by another magnet might be sent over the same wire at the same time and be received on a separate magnet adjusted to the second note formed the basis of a system of multiplex telegraphy which has already reached to great importance, and from which the telephone itself is but an outgrowth.

Prof. Gray was led to these inventions by a domestic incident. In a paper before the American Electrical Society, of Chicago, on "Transmission of Musical Tones," read March 17, 1875, he says: "My nephew was playing with a small induction coil, taking shocks for the amusement of the younger children; he had connected one end of the secondary coil to the zinc lining of the bath tub, which was dry; holding the other end of the coil in his left hand he touched the lining of the tub with the right; in making contact his hand would glide along the side for a short distance. At these times I noticed a sound was proceeding from under his hand at the point of contact, having the same pitch and quality of the vibrating electrome. I immediately took the electrode in my hand, and, repeating the operation, found to my astonishment that by rubbing hard and rapidly I could make a much louder sound than the interruptor or electrome. I then changed the pitch of the vibrator and found that the pitch of the sound under my hand was also changed, agreeing with that of the vibrator.

"One of the earliest discoveries in connection with these experiments was the fact that not only simple but composite tones could be sent through the wire and received, either on the metal plate or on a magnet. Not only could a simple melody be transmitted, but a harmony or discord could be communicated equally well. If the tone thus produced could be analyzed at the receiving end it would, of course, lead the way to a multiple Morse, a fast printing, an autographic and other systems. By this curious method, therefore, not only may different messages be sent simultaneously, but a tune with all its parts may be sent through hundreds of miles of wire and be distinctly audible at the receiving end."

Thus we see that at this early date he was already on the verge of discovery of a practical telephone. On Feb. 14, 1876, Elisha Gray filed at Washington a caveat for "Art of transmitting vocal sounds telegraphically." This was the earliest application of the kind in the world, and reads thus, "It is the object of my invention to transmit the tones of the human voice through a telegraphic circuit and reproduce them at the receiving end of the line so that actual conversation can be carried on by persons at long distances apart. I have invented and patented methods of transmitting musical impressions of sounds telegraphically, and my present invention is based upon a modification of the principle which is set forth and described in Letters Patent of the United States, granted to me July 27, 1875, Nos. 166,095 and 188,096, and also in an application for a patent granted to me Feb. 23, 1875."

Contemporaneous workers with Prof. Gray in the same line were Prof. A. E. Dolbear and Prof. A. Graham Bell, the latter of whom, though probably anticipated in point of time by the caveat of Gray, was granted a broad patent for speaking telephones on March 8, 1876,



PROF. ELISHA GRAY.

only 23 days later than the date of Prof. Gray's caveat.

As to who was entitled to the credit of the invention of the telephone it has required almost constant litigation in the courts for the past sixteen or seventeen years to decide, and although it has been awarded to Bell there are many dissenters to the justice of this decision.

Prof. Gray's characteristic as an inventor is in avoiding mere mechanical devices to accomplish results; intricacy, in his mind, is failure.

He seeks to make electricity do its work direct, and, therefore, endeavors in his devices to train and harness it for that purpose.

Passing over many other original inventions overshadowed only because of the grandeur of that of transmitting articulate speech, for we must credit him with this invention, though the law denies him the usufruct therefrom, we come to his latest—and shall we say most important?—invention: The telautograph.

As written language has always succeeded the spoken, first in hieroglyphics, and then in more specific symbols, so we find transmitted communications following the same order, and Prof. Gray's inventions in chronological order following the same sequence in evolutionary development. Thus the transmission of articulate speech by electricity was followed by rapid methods of transmission of Morse and other hieroglyphics, these in turn to be succeeded at the present day by the transmission in a similar manner of ideas autographically expressed. For a description of his latest invention, the telautograph, we refer our readers to the accompanying article.

Prof. Gray still lives at Highland Park, near Chicago, and has in the past been connected as a member of the firm of Gray & Barton, of Chicago, and has been identified as an officer in the Western Electric Manufacturing Company of the same city. In manners he is affable and genial, inviting approach, and manifests his Quaker origin, which is not disguised in his personal appearance, by a proneness to interchange of confidence, which, so delightful to meet with, has not always worked to its possessor's advantage.

Prof. Gray is universally esteemed, both as a man and as a scientist, and the confidence reposed in him by the profession has found manifestation in various ways, not the least of which was his election to the arduous post and responsibilities of Chairman of the Committee on the Electrical Congress of the World's Columbian Auxiliary. In this last position with which he has been honored, he has been thrown into many trying situations, which would have discouraged and upset a less well balanced person, but which he has surmounted with dignity, and to the credit of himself and the trust so widely reposed in him.

## The Telautograph.

The transmission of articulate speech over considerable distances by means of mechanical vibrations of a string or wire set in motion by means of a diaphragm in unison with the sound vibrations, and reproduced by means of another diaphragm set in motion at the other end by these mechanical vibrations of the string, was known to the Chinese, it is believed, before the Christian era.

The transmission of speech over even greater distances by means of electrical vibrations set up in a conductor by sound vibrations transmitted through a diaphragm and reproduced as such at the further end by a similar diaphragm set in action by means of these electrical vibrations is a discovery of the last decade, and what changes has it wrought! The fac-simile reproduction of written characters at a distance by a receiving pen or stylus mechanically connected with the transmitting pen has also long been known in the arts, and has reached its greatest perfection in the familiar pantograph now so largely used in the daily routine of the artist, the architect, and the engineer. The distance through which the apparent large and complex movement of autographic inscriptions can be thus transmitted mechanically is exceedingly limited, however, and the pantograph and other similar instruments have found their use in fac-simile reproductions to a scale, near at hand, rather than in transcending space.

The telephone had no sooner become an accomplished fact than the question arose, "If the vibrations to which music and speech are due can be reproduced electrically in defiance of distance, may we not so connect our inscribing pen electrically with a similar one at similar distances as to cause the latter to reproduce with fidelity and simultaneously the motions intelligently directed at the near end?"

At the first blush the rapidly changing irregular curves of script and sketches, amenable to no law or equation, but subject only to the whim or vagaries of their author, would seem to require for their reproduction an intelligence and motive in exact consonance with those which gave them birth. It would seem to involve a complexity of mechanism little if any short of human intelligence, and marvelous as was the electrical transmission of speech, still more marvelous and impossible of accomplishment did the faithful transmission of autographic work appear to the lay mind.

To the engineer or the mathematician, however, the problem was much simpler, for the law that all forces or motions in a single plane, however complex, could be resolved into two rectilinear motions or lines at an angle to each other, and that these if recomposed would give as a resultant an exact fac-simile of that which gave them origin, was known. The transmission of rectilinear motions in speed and extent corresponding in every particular with their originals was in theory an operation of great simplicity, but the matter of detail was one which required great care and patience to determine. The law of the parallelogram of forces afforded a ready means both of resolving these curves into their rectilinear components at the transmitting end and determining their instantaneous resultants at the receiving end.

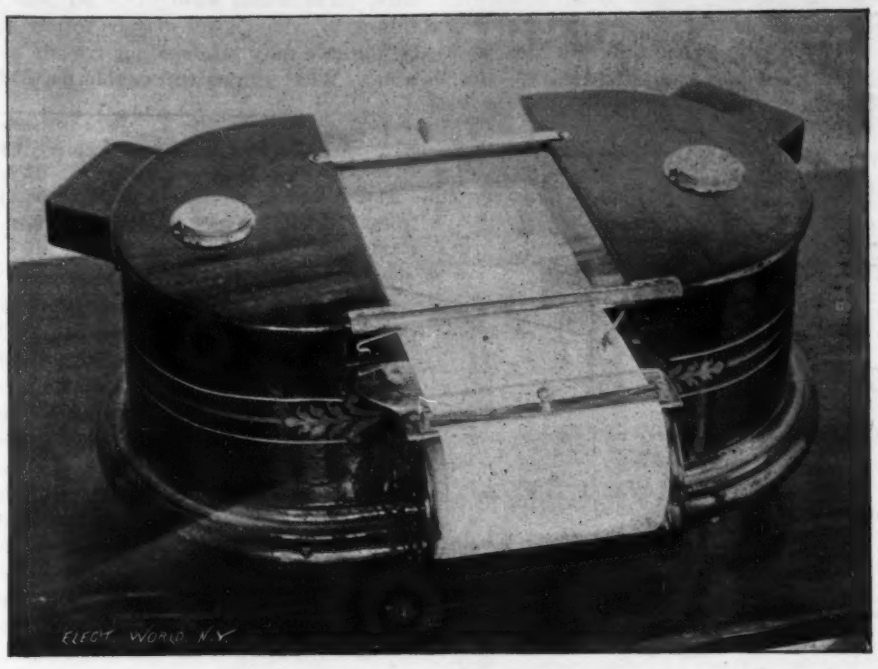
If a transcribing pen be placed at the focus of two cords at an angle of 90 degrees or other large angle, each passing over a drum or pulley of its own and kept in tension by means of a weight attached to its other end the motions of these weights as the pen moves will represent in speed and extent the rectangular components of the motion described.

The problem now became how to reproduce the component motions in exact fac-simile at the other end, and to recompose their instantaneous values by the parallelogram of forces at that end. This was the problem which Prof. Elisha Gray had set for himself and the practical solution of which was given ocular demonstra-

tion before the press of New York and Chicago on Tuesday, March 21, at the respective offices of the Gray National Telautograph Company, at 80 Broadway, New York, and in the Home Insurance Building in Chicago.

Accompanying this sketch is a diagram giving both the transmitting and receiving mechanisms, represented, for convenience of description, side by side. There are also given photographs of the commercial instruments as now ready for the market, and a copy of the original of some autographic work and its reproduction through an artificial resistance corresponding to about a mile of wire.

It may be well to premise that since two motions, each




THE TELAUTOGRAPH RECEIVER.

independent of the other, are to be reproduced, two electrical circuits are involved in the transmission. And since it is a well known fact that pulsations of successively opposite polarity can be sent over a line wire with greater rapidity and certainty of effect than pulsations of successively like polarity, alternating currents are employed in both these circuits. Since the mechanism in both of these lines is identical a description of one will answer for both; it being understood that wherever the singular is used a duplicate is implied.

In Prof. Gray's original patent, filed June 13, 1888, and issued July 31 of the same year, the following claim will be largely self-explanatory. Claim 11 reads "The combination with two main circuits, each including a pole changer, an interrupter, receiving magnet, and a polarized relay, arranged to direct the current through one or the other of the magnets, according to its polarity, of a transmitting pen connected to operate said interrupters by its movements in two directions crosswise of each other, two local circuits, each including the magnet of one of the pole changers, and a circuit maker and breaker, which is also connected to and operated by the pen, to change the condition of its local circuit, and thereby change the polarity of the current over the corresponding main circuit when the movement of the pen in either direction is reversed and a receiving pen moved in two directions crosswise of each other through the action of the magnet of the respective circuits and in opposite directions through the action of the respective magnets of each circuit substantially as set forth."

In the completed machine he has arranged a series of contacts over which there wipes a brush so that the number of pulsations in that circuit is determined by the distance which the pen is moved in that component direction, and the speed of succession of the pulsations varies with the rapidity of movement in that component direction of the transmitting pen. Referring to the diagram, A represents the pen or pencil of the transmitting instrument attached by flexible cords at right angles to each other to two drums concentric with the sunflower contact B and C. Rigidly attached to these drums are brushes which as the drums are revolved sweep over the contacts in the direction of revolution. Also attached to each drum is a lever arm which makes contact either with a front or rear stop, as the direction of revolution is forward or backward, thus changing the direction of motion at the receiving instrument simultaneously with that of the transmitting pen as will be further described. The alternating current for each circuit is supplied by two batteries, one at either end, so connected as to oppose each other. The battery at the transmitting instrument is usually made of about twice the strength of the other, and the connections to the sunflower as the brush sweeps around is such that at successive contacts first both batteries are in action and then but one; the result being that when both are in circuit the transmitting battery overpowers the receiving battery with its excess of voltage and gives a current in one direction, whereas when but one is in circuit an equal impulse in the opposite direction is obtained and an alternating current is thus produced, the number of

whose pulsations is determined by the angular movement of the brush and the speed of succession by the rapidity of this angular movement.

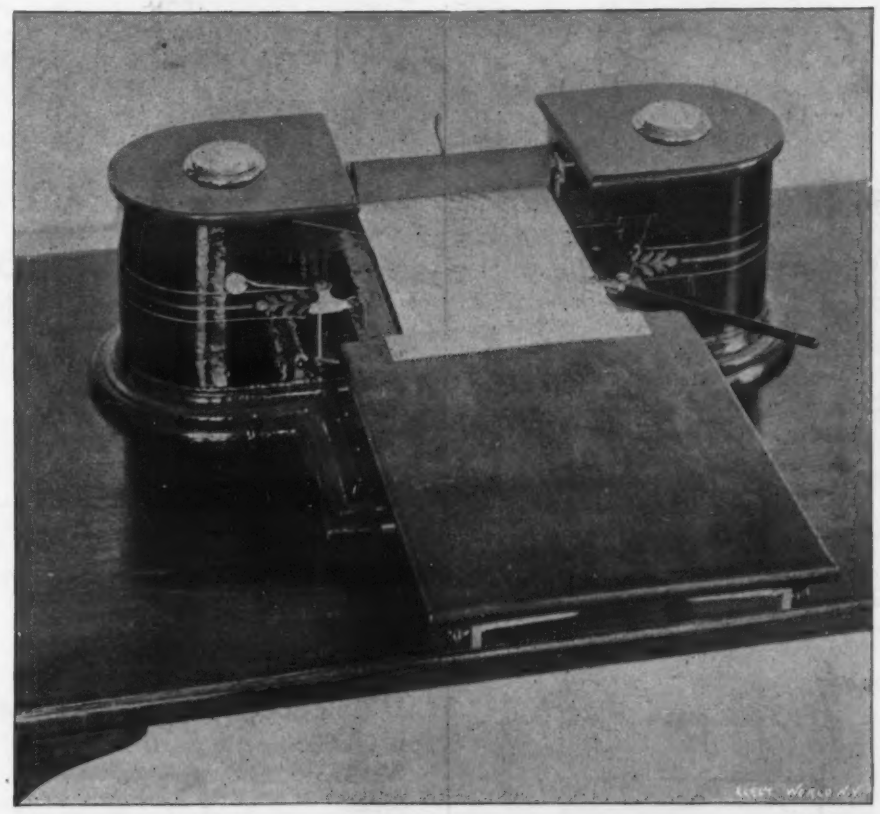
Since the movement of the pen A is resolved into its rectangular components by means of the two cords which wind upon and unwind from the drums, the same are reproduced in units of electrical pulsations by the angular motion of the brush on the sunflower. In the receiving instrument two drums also are provided which actuate the stylus by two arms at an angle to each other similar to that of the cords in the transmitting instrument. The mechanism provided for the driving of these drums consists of a set of magnet weights, one set for each of the two crosswise directions of motion of the transmitting pen. Each of these sets consists of two magnet clutch weights, each weight being suspended from a disc mounted upon the prime motor shaft and arranged to be clutched to that shaft at proper intervals to raise the weight by power furnished from an independent source.

Each of these magnet clutch weights is also connected to the drum from which the receiving pen is driven, through the agency of the magnetic clutch, in such a manner that they alternately act upon the said drum to drive it in alternately opposite directions. An escapement attachment is also provided so that as each impulse is received the escapement permits the revolution of the drum by the weight through a distance equivalent to one-half a tooth. This being the unit of movement in the receiving instrument, the extent of movement in each rectangular component will be measured by the number of impulses received over the line and the rapidity of that movement by the rapidity with which these impulses are received. Thus we have the rectangular components of the transmitting pen reproduced both in extent and rapidity at the further end, and combining these two to the receiving stylus by pivoted arms the former is compelled to follow the resultant of these instantaneous values and the fac simile reproduction results.

The paper is fed to the transmitting instrument from a roll, which is moved by the sender as the length of the message requires. The course of this paper leads over a metallic plate, some 2½ inches wide and about 4 inches long. An area of this extent can be written upon without motion of the paper. The plate itself forms an excellent writing surface upon which to place the paper for transcribing the message, but it has a more important office to fill, as it forms a connecting link between the two sets of batteries which supply the transmitting currents. Normally these are broken, and the receiving pen is held from contact with the paper at the further end by a spring actuated lever arm. The slightest pressure of the transmitting pen, however, upon the paper above the metallic plate is sufficient to close the circuit and to bring the receiving pen in contact with the paper at that end in readiness to reproduce the characters transmitted; thus, whenever the transmitting pen is lifted from the paper, as at the end of a word, or the end of a sentence, or to cross a t or to dot an i, the receiving pen is also lifted synchronously, and no mark is made at the receiving end until the transmitting pen is again in contact with the paper. The directive currents, however, are continued, and any motions made by the transmitting pen while out of contact with the paper will be reproduced at the receiving end in the air by the receiving pen. In this way, a new line is commenced at the proper interval and the dot for the i, the cross for the t, or the punctuation marks, fall into their proper place at the further end.

When the area of the metallic plate, or as much of it as is desired, has been filled by the sender, and additional space is required, the movement of a lever on the transmitting instrument advances the paper the proper distance, in a manner similar to that employed in our typewriting machines; the movement of this lever produces a simultaneous movement of the paper on the receiving instrument, so that the spacing of the lines and the length of the message received correspond exactly with the message transmitted. Since the transmitting pen plays no part but a directive one, anything may be used for this purpose—one's lead pencil, a stylographic pen, or even a toothpick, will be equally effective. The chief essential in the receiving pen is that it shall be capable of registering the rapidly changing curves with certainty and with as little friction as possible. A pen somewhat similar to that employed in Lord Kelvin's siphon recording instrument is, therefore, used, which consists of a glass tube drawn out at its end to capillary proportions, and this filled with an easily flowing ink.

While some of the details are too complicated to permit of description within the limits of this article, enough has been said to give a clear idea of the fundamental principles employed in this instrument. It will be seen at once that complicated as the problem at first seems,



THE TELAUTOGRAPH TRANSMITTER.

its solution has been obtained through exceedingly simple means, the complication referred to being more apparent than real.

The instrument itself is intended as an instrument for the people, and in this sense is as simple as the telephone itself, and may be successfully operated as readily by a child who can do nothing more ambitious than to execute an awkward scrawl as by the most experienced and erudite electrician of the land.

It is intended in its introduction to follow out closely the line so successful in the telephone exchange business; in fact, it is intended that subscribers shall be connected to one another through central exchanges and switchboards in exactly similar manner. It will have one ad-

vantage in this connection over the telephone exchange, in that in the latter the operator, if he chooses, may become conversant with the messages transmitted, but in the former there will be no possibility of such leakage, and the message will be as inviolate from profane eyes as if written at home and transmitted in secrecy through the mails.

To call a subscriber, the operation is exceedingly simple: A in his office merely writes on the paper, "A wants B," when the operator at the central station makes the proper connection, and the line is then open for the most sacred secrets of the two subscribers, and to them alone.

As to speed of transmission, that is limited only by the speed with which the subscriber is able to write. It is possible for some to write at a speed of from 30 to 35 words per minute. The average speed for telegraphic communications is said to be about 26½ words per minute.

The current employed in the telautograph is about the same as that employed in the telegraph, and the distances it is possible to reach are about the same as those which can be reached with the Morse signals without the intervention of relays, and may be said to be about 500 miles.

While the relay has not yet been adapted to telautograph transmission, it would seem to be readily adaptable to this service, and if so, the time may not be far distant when the banker in New York may attach his autograph to a check in San Francisco as readily as he now communicates with his broker through the intervention of the Morse code and the telegraph operator.

As before indicated, the exhibition of the telautograph was given to the press of New York and Chicago, there having been some 70 or 80 invitations issued by Prof. Gray. The full attendance on hand at the New York offices showed the interest evinced in the new invention, and many were the expressions of surprise and admiration of the workings of this the latest invention brought before the public in this most wonderful era.

At the offices of the company, at No. 80 Broadway, there were on this occasion exhibited four distinct sets of the instruments connecting the various rooms through a switchboard apart by itself, and thus all the operations of a central exchange business were duplicated before the eyes of the invited guests. In addition to these there were two sets of instruments, each consisting of a transmitter and receiver placed side by side, so that the observer might witness with one glance of the eye both the sending and receiving of the message.

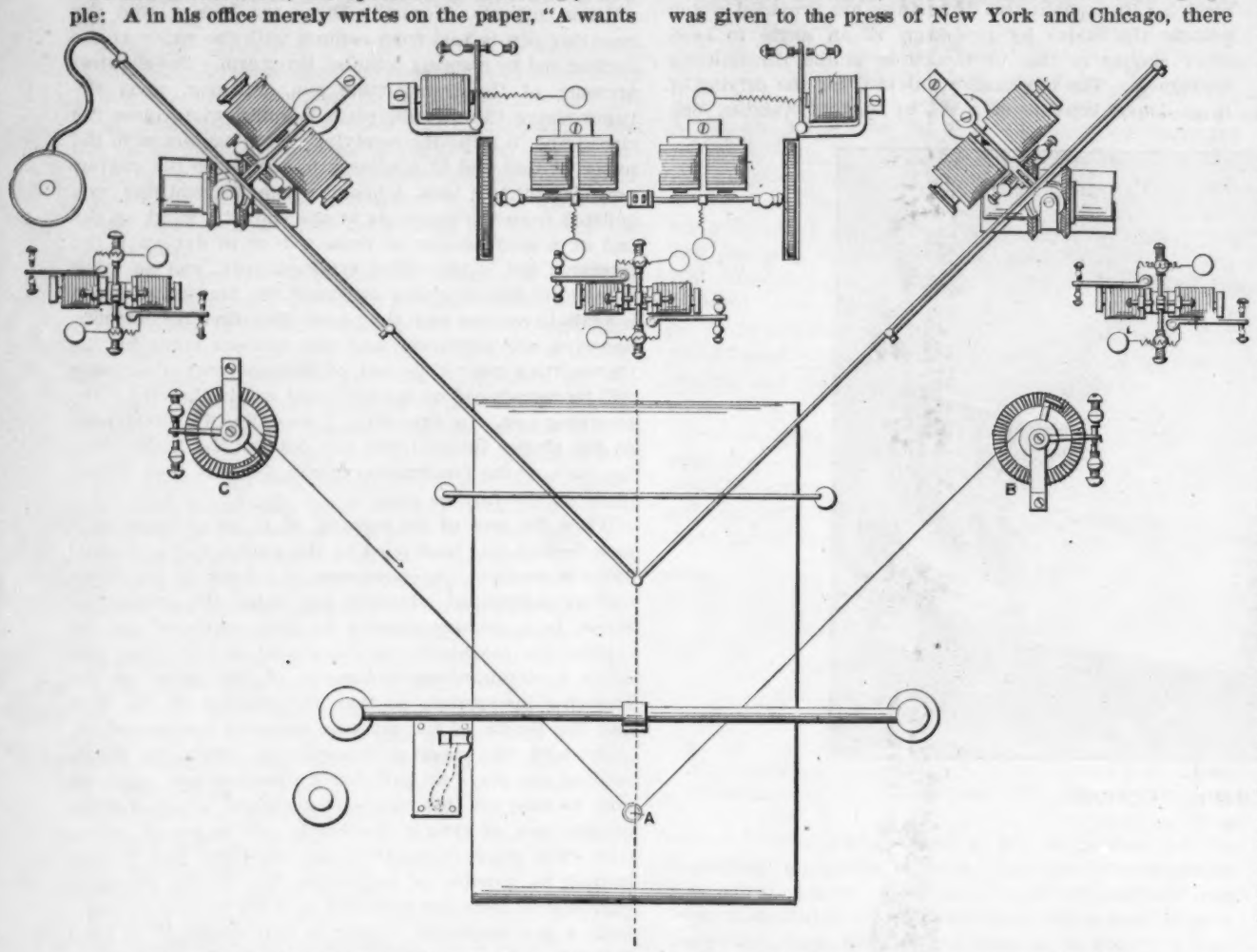
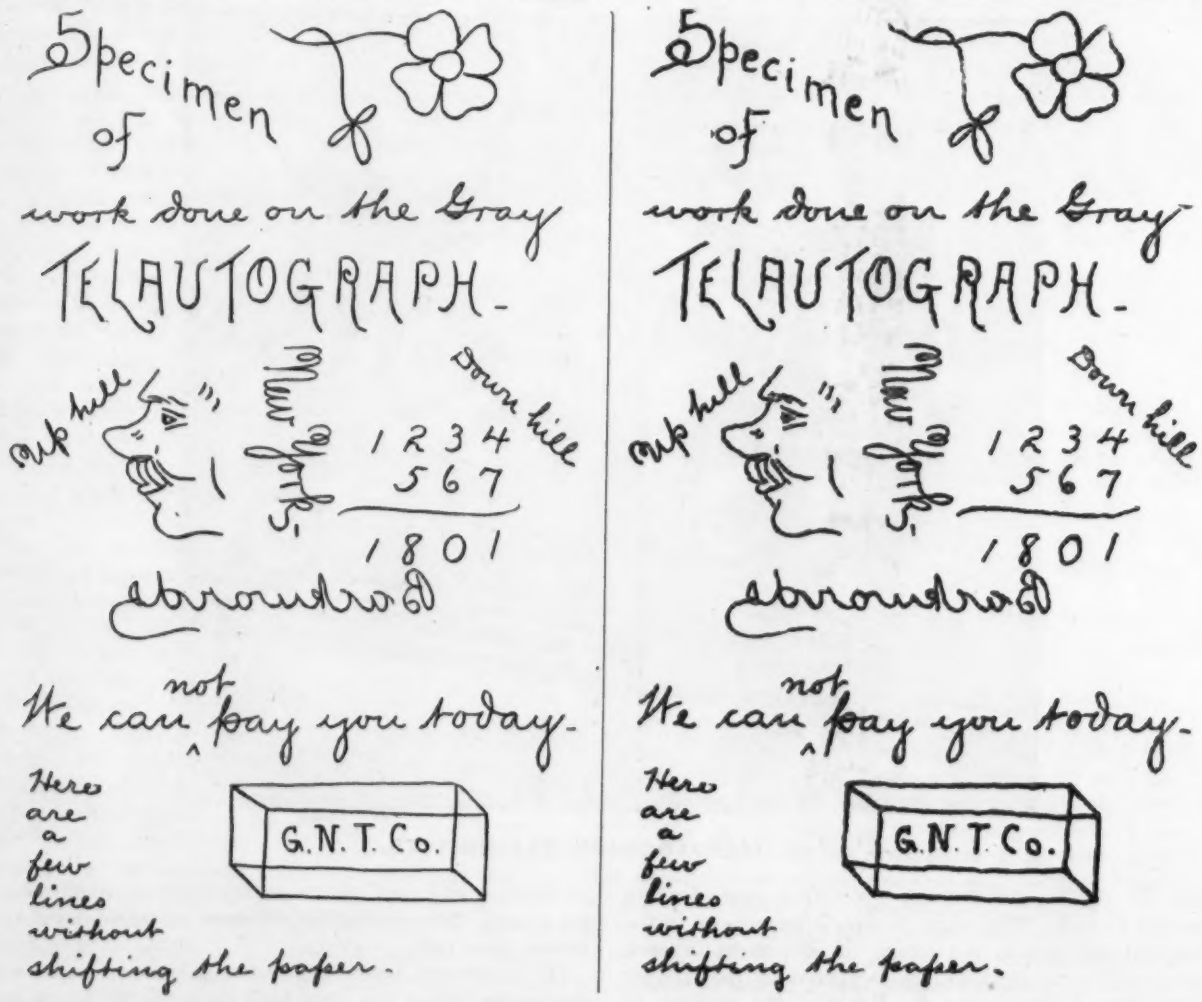



DIAGRAM OF THE TELAUTOGRAPH RECEIVING AND TRANSMITTING INSTRUMENTS.




As Written. A TELAUTOGRAM. As Received.

Though the actual lengths of the line over which messages were transmitted at this exhibition were necessarily short, artificial resistances were introduced to make them equivalent to a separation of about one mile.

One of our cuts represents a message as written, and another the same as it was received. This shows most clearly the elasticity of the system and the fidelity of reproduction, for in this it will be seen that not only printing and script, which in the original were transcribed horizontally, uphill, downhill, and backward, but sketches were equally well reproduced, at the further end.

Now that we can recognize the voices of our friends and communicate with them in autograph over miles of wire, there would seem to be but one step left for the future, by which space may be totally annihilated; namely, that we may also see our friends as they speak and write. What genius will enable us to do this?

## The Incandescent Lamp Situation.

The following communication was recently received from Mr. F. S. Terry, manager of the Ansonia Electric Company, of Chicago:

*To the Editor of The Electrical World:*

"Sir: I have written you several times in reference to the incandescent lamp situation. We are noticing the effect on our business, and the seriousness of the situation is becoming, as time goes on, even more apparent. I have been informed that the remarks at the St. Louis Convention in reference to the incandescent lamp will be suppressed in the official reports. I hope at least that the electrical papers will not leave out those remarks, as I think the statements made by Mr. T. Carpenter Smith were entirely correct, show the situation much as it is without exaggeration, and were fair to all sides. While I do not expect that the electrical papers will entirely agree with me in my conclusions, I do hope that they are not afraid to treat the matter from the standpoint of what may be considered best for the electrical industry as a whole, and without fear of offending either the trust interests, or those opposed to it. I would suggest the following as subjects for editorials that would be interesting, and I would be glad to supply some facts to assist in preparing them:

"1st. Is it possible for the General Electric Company to obtain control of the lighting industry?

"2d. Should the General Electric Company obtain control of the lighting industry, would the effect on the electric lighting business on the whole be beneficial or otherwise?" F. S. Terry.

Attention might be called to the fact that not only did The Electrical World not suppress the remarks made at the St. Louis Convention in reference to the lamp situation, but that it was the only electrical journal with the exception of "The Electrical Review," that published more than the merest reference to them. While we are not authorized to speak for the National Electric Light Association on the subject, we certainly believe that what Mr. Smith and others had to say at St. Louis regarding the lamp question will be duly published in the official report of the convention.

The columns of The Electrical World are open for brief contributions upon this, as upon any subject of general interest. While such contributions should preferably appear under the name of the author, communications will gladly be received from those who are unwilling that their names should be made public.

Copies of Mr. Terry's letter were sent to a number of prominent electrical engineers, lamp manufacturers and others more or less directly connected with the lamp industry or interested in it. As was anticipated, the replies, while expressing widely varying opinions upon the points in question, were written with great caution, displaying a tendency on the part of the writers to be as non-committal as possible. In fact, the subject was one which they were quite unwilling to attack, and while a few faithful followers of either side bravely took up the lance in defense of their respective interests, it was evident that the majority thought discretion the better part of valor.

The representative of an "outside" lamp manufacturing company, with a touch of sadness, replies briefly as follows:

"I fail to see that it would be wise to enter upon such a discussion as you propose, concerning the electrical business, as the two questions proposed in Mr. Terry's letter are ones of fact and not theory, and, in my opinion, entirely too much prophesying has been done in the past concerning the ultimate outcome of this business."

The following communication is from one who is well qualified to speak upon this subject:

"It hardly seems possible that the General Electric Company could obtain entire control of the lighting industry, although, to be sure, it might be possible; consolidations have been so great and so many things have been accomplished.

"I think it may be stated, as a rule, that these things are not beneficial to our industry, and I do not see why there should be any exception to the rule in this case. Personally I should be very sorry to see this control, for fear of the evil effects that would come. Human nature is much the same wherever you may find it, and the

many objectionable features of monopoly would soon show themselves, I fear."

The general manager of a manufacturing company well known in electrical circles offers the following opinions:

"While we have nothing particular to say regarding the matter for publication, we think he (Mr. Terry) is entirely correct in his stand.

"It certainly is no more than fair to electrical interests, outside of the General Electric Company, that a free and fair discussion of the points mentioned should be taken up in the electrical papers. The matter is of as vital importance to the papers as it is to the outside manufacturers.

"We trust that you will open your columns and give the public both sides of the question."

A prominent central station man gives evidence of his charity as follows:

"In replying to your favor, with the inclosure of communication of F. S. Terry, the part of that communication which you specially refer to is unquestionably of great moment to the already established companies. As to its effect, that would depend altogether upon the integrity and honesty of the General Electric Company. I must confess my faith in them in this respect is very weak. As I could write nothing without impeaching them, I prefer not to write at all."

Mr. F. R. Upton, whose past experience and present position give force to his opinion, defends the position of the General Electric Company in the following language:

"I do not know exactly what Mr. Terry fears, unless it be the fact that the courts will decide to fix the responsibility attached to the making and handling of incandescent lamps.

"As far as the General Electric Company controlling the industry, I do not see how this is possible, when an electric lighting plant consists mainly of articles which are uncontrollable.

"I am familiar with the history of the art, and know that the electric lighting industry is under great obligations to Mr. Edison for his work upon the incandescent lamp, which work has done so much to make the industry a great one.

"I consider it shows very poor taste upon the part of Mr. Terry, who represents a company which has handled for years incandescent lamps which are now known to have been made under the patents of Mr. Edison, to complain against a situation which he should have known was sure to come about."

There is, perhaps, no one better able to express an intelligent opinion upon this important question than the author of the following, who, however, does not wish his name published:

"My professional connection with this litigation about the incandescent lamp is such that it would not be proper for me to give formal expression to my private opinion on the questions propounded by Mr. Terry. I will say, however, that it is quite possible that the General Electric Company will be able for a time to get absolute control of the incandescent lamp business, for the chances are, of course, in favor of their success in the pending litigation with the Western lamp manufacturers, and in that event they have only to make lamps fast enough to supply the market, and they will be secure from interference from the courts, probably until their Canada patent expires next year. But I do not see that this necessarily gives them control of the electric lighting industry, any more than it did in England. I do not think the control of the business by any one interest is likely to be beneficial to it, but that is merely my individual opinion. There are instances in which a monopoly has proved beneficial to the consumer, of which Standard oil is an example, but in a business so specialized, and involving such a vast number of diverse minor industries, I believe that many smaller concerns can produce the goods cheaper than a large one, while the stimulus of competition fosters invention and improvement, as well as economy of production. The trouble the General Electric Company will meet with in seeking to control all electrical industries is likely to be a financial one. If the central station men are pressed too hard, nothing will be easier for them than to start a co-operative manufactory.

"If the Edison company had had at the outset the faith in their own patent to inforce it vigorously in the way that the Bell telephone people did, they might have been in as strong a position. But they contented themselves with windy proclamations, and did not do anything. This was a fatal mistake, and, in my opinion, it is too late to retrieve it."

## Electric Tanning.

Mr. Buse, Jr., in the January number of the Bulletin of the Belgian Society of Electricians, gives, in a semi-popular style, a comparison of various methods, particularly those of Worms and Bale, with that of Groth. He sums up the advantages of electric tanning over the old method as follows: Ease and rapidity; almost complete absence of manual labor; no skilled workmen; a possibility of having a production in proportion to the demand; the possibility of giving the leather any color desired.

## Theory of the Transformer.*—1.

BY F. BEDELL AND A. C. CREHORE.

### Introductory.

The theory of the transformer has been the subject of so many papers and its action has so often been the subject of discussion, that originality of treatment can scarcely be looked for, as the matter has been carefully studied from every standpoint. Sufficient interest is taken in the subject, however, to make it worth while to take it up again and set forth some of the fundamental facts and principles, the statement of which, while not constituting a novel treatment, may bring out some new relations and may serve to make the old relations more familiar.

The action of a transformer depends upon the mutual action between two circuits in no way electrically connected, this mutual action taking place through the medium of the magnetic field or the magnetic circuit of the transformer. Before analyzing the effects of one circuit upon the other, we must first investigate the nature of he magnetic circuit, the medium through which the

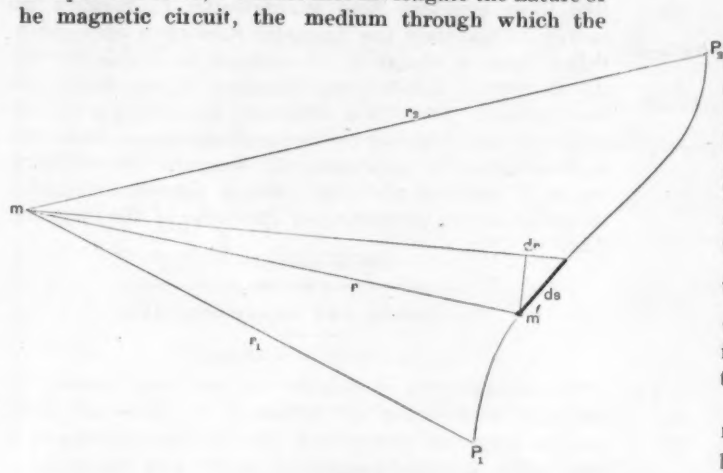



FIG. 1.

mutual influences are felt. The discussion of the transformer proper is therefore deferred for the present, to be taken up in a following paper.

#### MAGNETIC EFFECT OF A CURRENT.

It has been found, as a result of experiment, that the magnetic effect of a current is the same as that of a magnetic shell of suitable strength, having for its boundary the circuit in which the current flows. By a magnetic shell is meant a very thin sheet of magnetic material magnetized in the direction of its thickness. We here follow some lecture notes by Prof. Merritt. The strength of shell, j, is equal to the magnetic moment per unit area—that is, $j = \frac{m\,l}{A}$, where m is the pole strength and l the distance between the poles of the magnet with cross-section A. A shell of uniform strength, j, having the same boundaries as a circuit in which the current, i, is flowing, will exactly replace the current, so far as magnetic effect is concerned, when i and j are numerically equal.

#### WORK DONE IN MOVING A MAGNETIC POLE.

In moving a magnetic pole in a magnetic field work is done either by the magnetic force or against it. Suppose that we have two magnetic poles of strengths m and m′, and that $r_1$ is the distance between them. If m′ is moved from the point $P_1$ (Fig. 1) to $P_2$ so that the distance be-

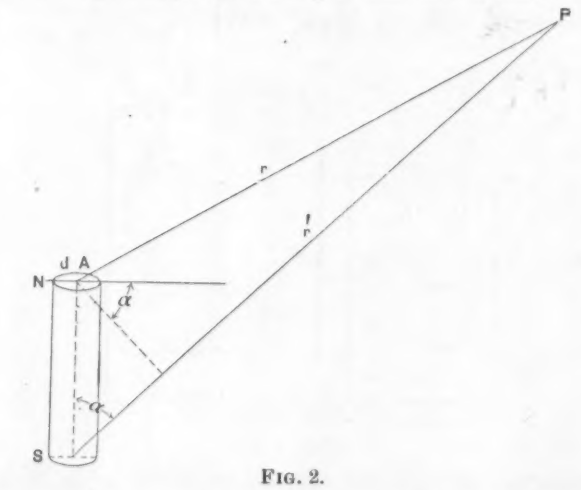



FIG. 2.

tween m and m′ is increased from $r_1$ to $r_2$, work is done. The work done in thus moving m′ from $P_1$ to $P_2$ can be found by first ascertaining the work done in moving m′ over an element of distance ds, with an increase dr in the distance r from the magnetic pole m. The force at any time between two poles of strengths m and m′ at a distance r apart is:

$$\text{Force} = \frac{m\,m'}{r^2}.$$

This force may be considered constant while the pole m′ is moving through an element of distance ds. The component of the force in the direction of ds, that is in the direction of the path by which m′ is moving from $P_1$ to $P_2$, is

$$F_d = F.\frac{dr}{ds} = \frac{m\,m'}{r^2}\frac{dr}{ds}.$$

Now the work done in moving the pole $m^2$ through a distance ds is the product of the distance ds and the component of the force in the direction of ds, that is:

$$d\,W = F_{ds}\,.\,ds = m\,m'\frac{dr}{r_2}$$

To find the work done by the magnetic force in moving m′ from $P_1$ to $P_2$ this expression must be integrated between the limits $r_1$ and $r_2$; thus,

$$W = m\,m'\left(\frac{1}{r_1} - \frac{1}{r_2}\right);$$

or, the work done against the magnetic force is $m\,m'\left(\frac{1}{r_2} - \frac{1}{r}\right)$. This work is independent of the path, depending simply upon the pole strengths and upon the initial and final distances.

#### MAGNETIC POTENTIAL.

If the distance $r_1$ is infinite (meaning that the pole m′ is carried from an infinite distance to a point at a distance $r_2$), the work done against the magnetic force becomes

$$W = \frac{m\,m'}{r_2}.$$

If m′ is unity and a unit pole is moved, the work becomes

$$W = \frac{m}{r_2}.$$

It is seen that each point in the region surrounding a magnetic pole possesses a certain characteristic which determines the amount of work done in bringing a unit magnetic pole from infinity to that point. This characteristic of the point has been called its *magnetic potential.* The magnetic potential V at a point is therefore defined as the work done in moving a unit positive pole from an infinite distance to that point; thus, $V = \frac{m}{r}$. This potential is positive when the work done is positive; that is, when work is done, in moving the charge, by some agent external to the system.

The potential at a point due to a number of magnetic poles is the sum of the potentials at that point due to each pole independently, thus:

$$V = \Sigma\,\frac{m}{r}$$

#### TO FIND THE MAGNETIC POTENTIAL AT ANY POINT DUE TO AN ELECTRIC CURRENT.

Take the case of current flowing in a single turn of wire. In determining the potential we may replace the current, I, by a magnetic shell of strength, j, in the form of a disc. This disc may be imagined as made up of a large number of very short bar magnets placed side by side. Then the potential at any point will be equal to the summation of the potential due to each little magnet considered separately.

If the area of the polar surface of one of these little magnet poles is dA, its pole strength dm, and its length l, then $\frac{dm}{dA}$ is the strength of pole to which a unit area is equivalent, or it represents the surface density of the magnetism and may be denoted by $\sigma$. The strength of the shell may now be defined as the product of $\sigma$ and l; that is,

$$I = j = \sigma\,l = \frac{d\,m}{d\,A}\,l.$$

The potential at P, Fig. 2, due to the elementary north pole, N, is $dV_n = \frac{dm}{r}$ and that due to the elementary south pole, S, is $dV_s = -\frac{dm}{r'}$. The potential due to the whole elementary magnet is

$$dV = dV_n + dV_s = \left(\frac{1}{r} - \frac{1}{r'}\right)dm.$$

For r′ we may substitute $r + l\cos\alpha$; thus,

$$dV = \left\{\frac{1}{r} - \frac{1}{r + l\cos\alpha}\right\}\,dm = \frac{l\cos\alpha}{r^2 + r\,l\cos\alpha}\,dm.$$

Neglecting rl as infinitesimal compared with $r^2$, and writing I dA for l dm, we have

$$dV = \frac{I\,dA\cos\alpha}{r^2}.$$

But dA cos α is the projection of dA on a plane perpendicular to r, and, since dA is infinitesimal, is equal to the area cut out from a sphere of radius r and centre P by the cone whose base is dA and whose apex is at P; therefore,

$$\frac{dA\,\cos\alpha}{r^2} = d\Omega,$$

in which $d\Omega$ represents the solid angle subtended by dA as seen from P. We have, therefore,

$$dV = I\,d\Omega.$$

This is the potential at P, due to one of the little magnets, N S. Similar expressions hold true for the others, and the total potential at P, due to the whole shell, is

$$V = \int I\,d\Omega = I\int d\Omega = I\,\Omega, \qquad (1)$$

$\Omega$ being the solid angle subtended by the whole shell. $\Omega$ depends merely on the boundary of the shell; i.e., on the form and dimensions of the circuit. This theorem is due to Gauss' "General Theory of Terrestrial Magnetism," § 38, and the solution here given is the same as that given by Prof. Merritt in some notes. The theorem may be found in Maxwell's "Treatise on Electricity and Magnetism," Vol. II., § 409.

#### WORK DONE IN CARRYING A POLE AROUND A CIRCUIT.

For the point $P_1$, Fig. 3, in the plane of the coil and outside of it, the solid angle subtended by the coil is zero and $\Omega = 0$. As P moves along any path, $P_1\,P_2$, toward $P_2$, the

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solid angle increases, and at a point, $P_2$, in the plane of the coil and within the coil, $\Omega$ becomes equal to $2\pi$, for the solid angle subtended by a hemisphere is $\Omega = \frac{2\pi r^2}{r^2} = 2\pi$. Therefore in going from $P_1$ to $P_2$ the potential changes from 0 to $2\pi$ I. In other words, $2\pi$ I ergs of work are done in moving a unit pole from $P_1$ to $P_2$. The same amount of work must be done in carrying the pole back to $P_1$ along the path $P_2$ $P_4$ $P_1$. Therefore the total work done in carrying a unit pole once around a wire in which the current I is flowing is

$$W = 4\pi I \text{ ergs.}$$

If, instead of one turn of wire, there are S turns, around which the pole is carried, the work will be S times as much, and

$$W = 4\pi S I.$$

MAGNETIZING FORCE OF AN AMPERE TURN.

Work is the product of a force and the distance through which it acts; therefore,

$$W = \int \mathbf{H}\, dl = 4\pi S I, \qquad (2)$$

in C. G. S. units, where $\mathbf{H}$ is the magnetizing force for the element of length, dl.

In the case of a torus or anchor ring, wound uniformly

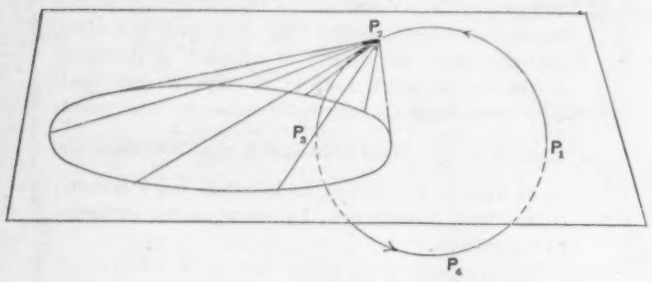



Fig. 3.

with wire carrying a current I, the force is constant at all points along any circle concentric with the ring; therefore, if l is the circumference of such a circle,

$$\int \mathbf{H}\, dl = \mathbf{H}\, l, \qquad \text{and}$$

$$\mathbf{H} = \frac{4\pi S I}{l} \qquad (3)$$

$\mathbf{H}$ is different, however, at different distances from the centre of the ring, being greater at points nearer the centre.

If the current is expressed in ampères and other quantities, as before, in C. G. S. units, the expression for the magnetizing force becomes

$$\mathbf{H} = \frac{4\pi S I}{10 l}. \qquad (4)$$

In the case of a long solenoid the magnetizing force is very nearly uniform throughout the length, and is much greater within the solenoid than at points outside. Since by far the greater work is done in carrying the pole through the solenoid, the work done in carrying it through the part of its path outside of the solenoid may be neglected, and $\mathbf{H}\, l$ may be taken as the product of the length of the solenoid and the approximately uniform magnetizing force inside it.

LAW OF THE MAGNETIC CIRCUIT.

We thus see that a current flowing in a conductor creates a magnetizing force in the surrounding medium, and the value of this force is given in the equations above. Now, the total number of lines that will be set up through the circuit due to the current depends not only upon the magnetizing force $\mathbf{H}$, but also upon the permeability of the magnetic circuit and upon its sectional area.

The total induction or magnetic flux N, is equal to the area times the induction $\mathbf{B}$ per square centimetre; thus,

$$N = \int \mathbf{B}\, dA.$$

When the induction is uniform this becomes

$$N = \mathbf{B}\, A.$$

But the induction per square centimetre is equal to the product of the permeability $\mu$ and the magnetizing force; thus $\mathbf{B} = \mu \mathbf{H}$. It therefore follows that $N = \mu \mathbf{H} A$ and $\mathbf{H} = \frac{N}{\mu A}$. Substituting this value for $\mathbf{H}$ in equation (2), we have

$$\int \frac{N\, dl}{\mu A} = 4\pi S I.$$

But for $\int \frac{N\, dl}{\mu A}$ we may write $N \Sigma \frac{1}{\mu A}$, and so

$$N = \frac{4\pi S I}{\Sigma \frac{1}{\mu A}}. \qquad (5)$$

The development of elementary principles regarding magnetic poles, magnetizing force, etc., may be found in a previous paper by the writers in The Electrical World,* and in the introductory chapter to our work on "Alternating Currents."†

This is the magnetic analogy of Ohm's law; the first member is the analogue of current, i. e., the magnetic flux or flow of force; the numerator of the second member is analogous to electromotive force and is called magneto-motive force; the denominator is the magnetic resistance or reluctance. The specific magnetic resistance of each part of the circuit is $\frac{1}{\mu}$, and this multiplied by the length and divided by the sectional area will give the magnetic resistance for that part. The total magnetic resistance $\rho$, first called reluctance by Mr. Oliver Heaviside, is found by summing up these partial resistances; that is, $\rho = \Sigma \frac{l}{A\mu}$. Although the idea of the magnetic circuit was not novel, yet Prof. H. A. Rowland* was the first to express its law in mathematical form.

The law may be expressed in words, thus:

$$\text{Magnetic Flux} = \frac{\text{Magneto-motive Force}}{\text{Reluctance.}},$$

$$N = \frac{\text{M. M. F.}}{\rho}.$$

Although the laws of the electric and the magnetic circuit are similar in many respects, it must not be supposed that these analogies hold throughout. It requires no energy to maintain the magnetic flow when once established; there is, therefore, no analogue to Joule's law for the energy continually being dissipated in heat during the current flow. There is a difference, too, between electric resistance and magnetic resistance or reluctance, inasmuch as the former is approximately constant for ordinary ranges of current, while the value of the reluctance of a magnetic circuit depends upon the value of the magnetic flux.

*(To be continued.)*

## Conductors and Insulators.—III.

DISASSOCIATION THEORY.

The phenomenon of dialysis has long been known. If we take some sugar and brown it, so that part of it can no longer be crystallized, and put the mixture in a cup made of folded parchment paper, and floated on a pan of water, the crystallized sugar will pass through the sides of the cup, while the uncrystallized part will remain for a much longer time. This has been explained by supposing that such uncrystallizable substances are colloid, or are formed of a great many molecules of the substance joined together so as to form one large molecule, and consequently not able to get through the pores of the parchment paper so easily as the smaller atoms of the crystallizable substance.

Apparently akin to this is the phenomenon of osmotic pressure. A bladder half filled with salt solution and placed in a pail of water will begin to take up more water till the level of the fluid in the bladder becomes several inches higher than the level outside of it. Then the pressure becomes so great that some of the salt solution is squeezed out of the bladder into the water, and gradually, when the strength of the solution in the pail is the same as that in the bladder, the levels become equal.

But suppose that instead of a bladder we had a membrane which was so constituted that a pressure of two or three inches, or even a hundred times that, could not

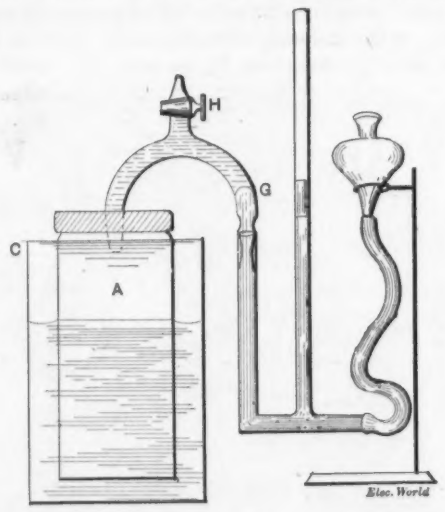



Fig. 11.

force the salt solution through its walls. It is plain that the level in the vessel whose walls are formed of this membrane would go on rising till a condition of equilibrium was reached between the force drawing the water molecules in and the pressure forcing them out, and it would stay there.

If, then, a salt in solution behaves like a gas, the volume of the liquid inside the membrane walled vessel should be just the volume which the salt would have if it were turned into a gas at the temperature of the solution, and under a pressure equal to that of the difference in head of the solutions in the membrane walled vessel and in the pail.

It would be very difficult, however, to make the experiment in this form, but there is another and (comparatively) easy way. Suppose, instead of relying on the head of the fluid for our pressure, we had simply sealed the top of the vessel. So soon as it was once full, no more water could get in, but the force drawing it in would be still there, and the pressure would go on increasing till, as before, it balanced the force attracting the water molecules. When this happened, the volume of the fluid inside the cell would be equal, as in the first case, to the volume the salt would have if it were turned into a gas at the same pressure and temperature as the solution.

The actual method of making the experiment is as follows: In Fig. 11, A represents a jar of porous earthenware, like a porous cell for a battery. This is too permeable by itself, so its pores are filled with a membrane of copper ferrocyanide. This is done by first soaking the jar thoroughly in a normal solution of copper sulphate, then rinsing it out, so as to remove the copper sulphate from the immediate exterior surface, and filling the jar with a one-third normal solution of potassium ferrocyanide. The latter solution, as it soaks in, combines with the copper sulphate to form a tough elastic skin of copper ferrocyanide in the pores of the cell, which is then, after being carefully cleaned, ready for use.

The cell is clamped in position in a vessel (C). Mercury is run up to the level of G, in the tubes G and E and in the reservoir F. A one per cent. solution is poured into the cell through the cock H, till the level of the solution comes up to the cock, which is then turned. The cap of the cell, from which the tube comes, has previously been firmly fastened down. The apparatus is now left to itself, except that as the solution is all the time tending to draw water in through the cell walls, the reservoir of mercury (F) must be constantly raised to a higher level in order that the line of separation of the mercury and solution may be kept at the point G. After a while it will be found that the pressure of the solution does not increase, though it may take months for this state of equilibrium to be arrived at. The pressure of the mercury column can then be read (adding the weight of the column of solution H G), and it will be found to be about 50 centimetres. The following are the results obtained by Pfeffer by this method of experiment, as given by Ostwald:

| A. | B. | C. |
|---|---|---|
| 1 | 53.5 | 53.5 |
| 2 | 101.6 | 50.8 |
| 2.74 | 151.8 | 55.4 |
| 4 | 208.2 | 52.1 |
| 6 | 307.5 | 51.3 |

Column A gives the per cent. of sugar in the solution. Column B gives the observed pressure in centimetres of mercury. Column C gives the ratio of the pressures to the concentration, and it is seen that the ratio is practically constant.

It remains to be proved that these pressures are the same as the sugar would have exercised if turned into a gas and compressed into the volume of the cell at the same temperature as the solution. The rough form of the equation connecting the pressure and volume of a gas is: $p\ v = R\ T$, where p equals the pressure, v equals the volume, R is a constant and T is the absolute temperature in degrees centigrade.

A molecule gramme (32 grammes) of oxygen, at a temperature of 0 degree C. or 273 degrees absolute, occupies 22,831 c. c. at a pressure of 76 centimetres of mercury or of 1,033 grammes. Therefore $1{,}033 \times 22{,}381 = R \times 273$. From this $R = 84{,}700$, approximately.

Pfeffer found the osmotic pressure of a one per cent. solution of cane sugar to be 49.3 centimetres of mercury, or 671 grammes at 0 degree C. As the formula for this sugar is $C_{12}H_{22}O_{11}$, its molecular weight is 342; and a one per cent. solution of sugar containing one molecule gramme, or 342 grammes, of sugar would occupy a volume of 34,200 c. c. For sugar, therefore, using the same formula as we did for gases ($p\ v = R\ T$) we find that $671 \times 34{,}200 = R \times 273$, or $R = 84{,}200$. As the value for R, which we got from oxygen, was 84,700, we see that R has the same value for both gases and liquids, and that the same law, connecting their volumes and pressures, holds for both at 0 degree C.

It might be questioned, however, if it held for other temperatures. The pressure of a gas kept at constant volume increases 1-273 for each rise of 1 degree C. It will be seen from the following table that the same holds good for solutions:

| A. | B. | C. | D. | E. | F. |
|---|---|---|---|---|---|
| Sugar | 54.4 | 32 | 14.15 | 51 | 51.2 |
| do | 56.7 | 36 | 15.5 | 52 | 52.9 |
| Sod. tart | 156.4 | 36.6 | 13.3 | 143.2 | 144.3 |
| do | 98.3 | 37 | 13.3 | 90.8 | 90.7 |

Column A contains the names of the substances tested, B the pressures observed at the temperatures given in C, E the pressures observed at the temperatures given in D, and F the pressures as calculated for the same temperatures as given in D.

But, as in the case of gases, many solutions form exceptions to this rule, and for the same reason. To take the case of a gas, when phosphorus pentachloride is heated till it vaporizes its pressure is much greater than it should be from the formula. But we know the reason for this, because from the green color of the vapor and other things, we know that the phosphorus pentachloride has been split up or disassociated into phosphorus trichloride and chlorine. Similarly, though sugar solutions follow the formula, a solution of salt does not, and for the same reason, i. e., it has been split up or disassociated into atoms of sodium and of chlorine. Here comes in the main difficulty, for it may be said: "It is

* "Elementary Principles Necessary to Establish the Equation of E. M. F.'s for a Circuit Containing Resistance and Self-Induction." The Electrical World, May 14, 1892.

† "Alternating Currents An Analytical and Graphical Treatment for Students and Engineers." W. J. Johnston Company, Ltd.

*Phil. Mag., series iv., vol. xlvi., Aug., 1873, "On Magnetic Permeability and the Maximum of Magnetism of Iron Steel and Nickel."

possible to understand how a gas may be disassociated by heating, for we may readily believe that when the molecules have been heated to a certain temperature, i. e., have had a certain amount of energy given them, the kinetic repulsion of one of the atoms from the other may drive them apart, and so split up the molecule. But in the case of NaCl, if the salt is split up into atoms of sodium and chlorine, what is to prevent the sodium atoms from combining with the water in which the salt was dissolved, to form caustic soda and hydrogen, as we know a lump of metallic sodium does when we throw it on a basin full of water?" This is a very hard question to answer, yet an attempt will be made to give one.

Before doing so, however, it may be as well to give some more reasons for believing that the statement made above is a fact, whether an explanation can be given or not.

The first relates to the freezing points of solutions, or, what is the same thing, the melting points of combinations of solvents and salts, since, as we saw above, the same pressure is exerted by a given number of molecules in a given volume of solution, whatever the substance of which the molecules are composed, in the same way as a given number of molecules of a gas, contained in a given volume, exercise the same pressure. Whatever the nature of the gas, we might suppose that a given number of molecules of a dissolved salt would exert the same effect on the melting point of the solution, whatever the nature of the salt. That this is the case actually, was discovered by Ravult, who gave a formula for the amount; the freezing point of water is lowered by the addition of a molecule gramme of any salt.

But salts which when dissolved in water conduct electricity do not obey these laws, but give in every case a greater lowering than calculated.

This is not due to the salts themselves, for if we dissolve an equal fraction of a molecule gramme of both sugar and salt in some solvent in which they are both soluble, and in which they cannot be electrolyzed, we shall find that both lower the freezing point the same amount. But if both are dissolved in water, the salt will give an abnormal lowering of the freezing point, and it will conduct electricity. It is the solvent, therefore, which has made the difference, and it has turned the salt into some state which is different from that in which the sugar is, and following the analogy of the gases, we may feel fairly certain that the abnormal pressure in the case of salt solution is due to the same cause as in the case of that of gaseous ammonium chloride or phosphorus pentachloride; i. e., to disassociation.

The second relates to chemical reactions. When we put a solution of silver nitrate into a solution of common salt, silver chloride falls down; the atoms of chlorine, being disassociated from the atoms of sodium, are free to combine with the disassociated atoms of silver in the silver nitrate, to form silver chloride, and so soon as it is formed, being insoluble in water, it falls down. But if instead of sodium chloride we had sodium chlorate, we would now obtain no precipitate, for the sodium chlorate molecules, when disassociated, spilt up into sodium and $ClO_3$ atoms and $AgClO_3$ is soluble in water. Therefore, we see that chemical reactions are not reactions on any particular element, but on a particular ion; that it is the presence of these ions which enable the reaction to be accomplished, and we might suppose that the greater the number of these disassociated ions, the faster the reaction would proceed or, the greater the amount of chemical change per unit of time, and also the greater the electrical conductivity. That this is a fact was proved by Ostwald, who, in a series of most important experiments, obtained the following results:

| A. | B. | C. | D. |
|---|---|---|---|
| Hydrochloric | 100 | 100 | 100 |
| Hydrobromic | 100 1 | 98 | 111 |
| Nitric | 99.6 | 92 | 100 |
| Benzine-sulphonic | 74.8 | 99 | 104 |
| Sulphuric | 65.1 | 73.9 | 73.2 |
| Formic | 1.68 | 1.31 | 1.53 |
| Acetic | .424 | .345 | .4 |
| Oxalic | 19.7 | 17.6 | 18.6 |
| Phosphoric | 7.27 | ..... | 6.21 |
| Arsenic | 5.38 | ..... | 4.81 |

Column A contains the names of the acids experimented on. Column B represents the chemical activity of the acids as measured by the rate at which they decompose a solution of methyl acetate into the free alcohol and acid. Column C represents the chemical activity as measured by the rate of inversion of cane sugar. Column D represents the electrical conductivity of the different acids. In all these columns the figures are relative, not absolute.

It will be seen that the chemical activity is directly proportional to the electrical conductivity. This great discovery of Ostwald's can only, as he points out, be explained on the supposition that both are proportional to the number of free or disassociated atoms or ions. Thus we find the following results:

1. All salts, when dissolved, exert a pressure equal to what the same quantity would exert if turned to a gas at the same temperature and pressure.

2. The only exceptions to this rule are those substances which, when dissolved, are disassociated to a greater or less extent into their ions. With these, as with a disassociated gas, the pressure is greater than calculated.

3. It is these exceptions only which can conduct electricity in solution, and the conducting power is proportional to the amount of disassociation.

It is here that we begin to get on firm ground, and can proceed to get a clear idea of what goes on in electrolysis.

*(To be continued.)*

## The Design of a Central Station for Incandescent Lights.—II.*

BY E. P. ROBERTS.

The accompanying map shows the location of such lights, and the character of the plan in which located, as the committee and myself believe obtainable at the start and the not distant future. It also shows the location of station A (being on property No. 1 on which your committee have obtained an option) and the location of the wires, if such station be decided upon.

The lights are distributed among the following:

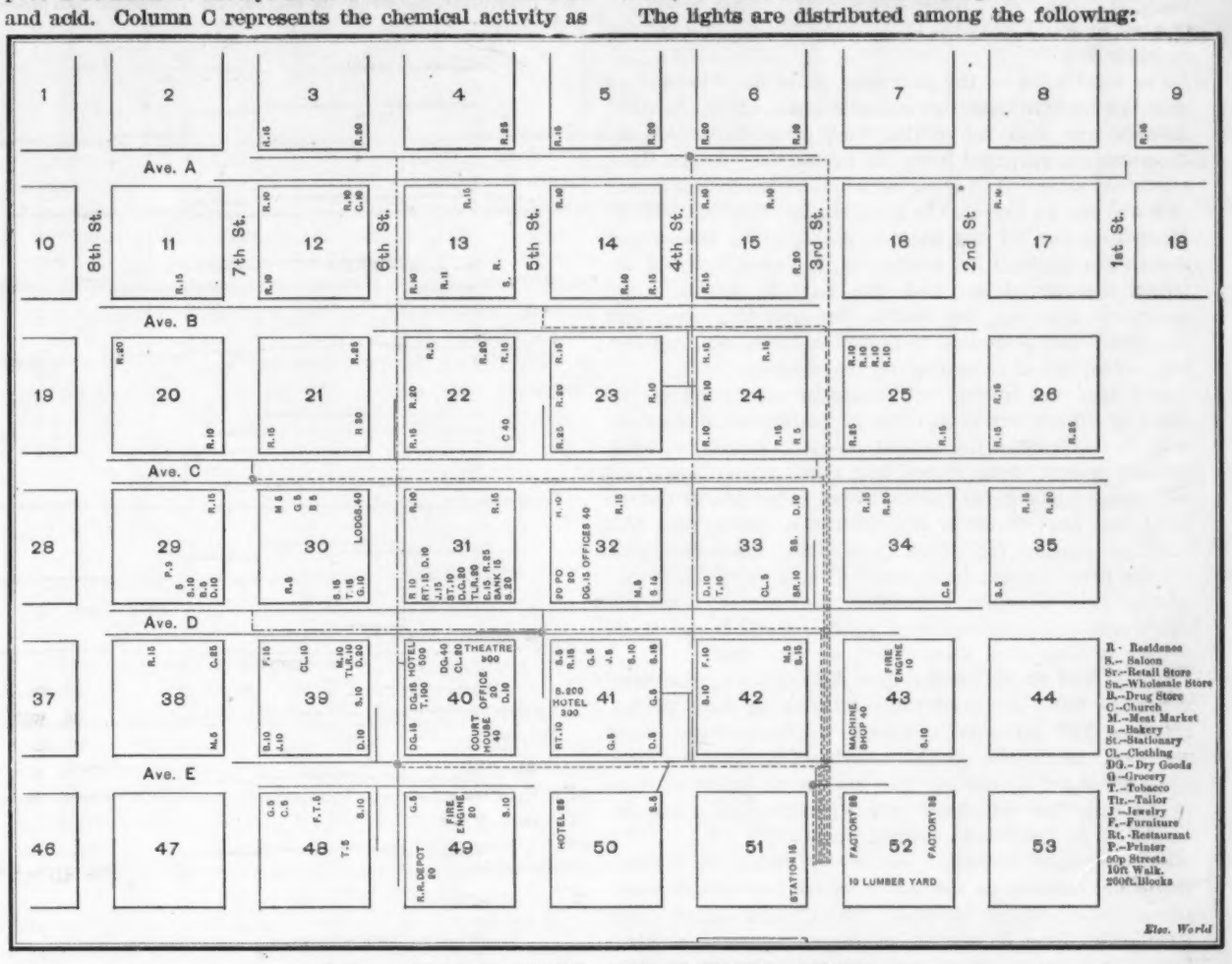



FIG. I.—MAP SHOWING LOCATION OF LIGHTS.

| | | | |
|---|---|---|---|
| 10 Grocers | 60 lights. | 5 Butchers | 30 lights. |
| 2 Stationers | 20 " | 8 Dry goods | 150 " |
| 5 Clothiers | 60 " | 4 Jewelers | 40 " |
| 3 Furniture and hardware. | 30 " | 2 Restaurants | 30 " |
| 1 Bank | 10 " | 5 Dairy stores | 60 " |
| 4 Cigar stores | 40 " | 10 Saloons | 115 " |
| 3 Factories | 100 " | 1 Lumber yard | 10 " |
| 4 Tailors | 50 " | 2 Printers | 25 " |
| 4 Wholesale stores. | 50 " | 2 Office buildings | 60 " |
| 67 Residences | 1,035 " | 1 Railway depot | 20 " |
| 1 Lodge hall | 40 " | 1 Court house | 40 " |
| 2 Engine houses. | 35 " | 2 Churches | 65 " |
| 3 Hotels | 825 " | 1 Theatre | 300 " |
| | | 1 Post office | 20 " |

The matter of city lighting is treated hereafter.

In order to determine the electrical output necessary for the entire demands, the character of machinery best fitted for the purpose; as to the number and size of dynamos, engines, boilers, etc., and also as to the probable total income and the comparative value of the various classes of customers, tables have been prepared showing the probable number of lights in use by each class of customers, at each hour, from dusk until daylight, which is the basis your committee advises, for the present. The furnishing of current, power and all day lighting is subsequently treated. The tables have been

* For the first section of this article see THE ELECTRICAL WORLD of March 4, 1893, page 158.

TABLE I.

| From plot of town. | | | 5-6 | | 6-7 | | 7-8 | | 8-9 | | 9-10 | | 10-11 | | 11-12 | | 12-1 | | 1-2 | | 2-3 | | 3-4 | | 4-5 | | 5-6 | | 6-7 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of places. | Character of places. | No. of lamps. | S. | W. | S. | W. | S. | W. | S. | W | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. |
| 10 | Groceries | 60 | ..... | 50 | 40 | 50 | 50 | 50 | 40 | 40 | 10 | 10 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 10 | 10 | ..... | 20 |
| 5 | Meat markets | 30 | ..... | 25 | 20 | 25 | 25 | 25 | 20 | 20 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 5 | 5 | ..... | 10 |
| 5 | Bakeries | 40 | ..... | 25 | 30 | 35 | 35 | 35 | 30 | 30 | 20 | 20 | 10 | 10 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | ..... | 10 |
| 2 | Stationers | 20 | ..... | 15 | 18 | 18 | 15 | 15 | 10 | 10 | 5 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ..... | 2 |
| 8 | Dry goods stores | 150 | ..... | 100 | 125 | 125 | 125 | 125 | 75 | 75 | 25 | 25 | 5 | 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | ..... | 5 |
| 5 | Clothiers | 60 | ..... | 40 | 40 | 50 | 50 | 50 | 30 | 30 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | ..... | 3 |
| 4 | Jewelers | 40 | ..... | 30 | 35 | 35 | 30 | 30 | 30 | 30 | 20 | 20 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | ..... | 3 |
| 2 | Hardware and | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Furniture store | 30 | ..... | 20 | 15 | 15 | 15 | 15 | 10 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ..... | 1 |
| 2 | Restaurants | 30 | ..... | 20 | 30 | 30 | 30 | 30 | 25 | 25 | 10 | 10 | 5 | 5 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | ..... | 10 |
| 1 | Bank | 10 | ..... | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | ..... | 2 |
| 5 | Drug stores | 60 | ..... | 30 | 40 | 50 | 50 | 50 | 50 | 50 | 45 | 45 | 20 | 20 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | ..... | 8 |
| 4 | Cigar stores | 40 | ... | 20 | 25 | 30 | 30 | 30 | 30 | 30 | 25 | 25 | 20 | 20 | 10 | 10 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | ..... | 5 |
| 10 | Saloons | 115 | ..... | 75 | 90 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 90 | 99 | 60 | 60 | 30 | 30 | 25 | 25 | 25 | 25 | 25 | 25 | 30 | 30 | ..... | 40 |
| 3 | Factories | 100 | ..... | 100 | 10 | 10 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | ..... | 10 |
| 1 | Lumber yard | 10 | ..... | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ..... | 1 |
| 4 | Tailors | 50 | ..... | 25 | 30 | 30 | 30 | 30 | 25 | 25 | 25 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | ..... | 1 |
| 2 | Printers | 25 | ..... | 10 | ..... | 5 | 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 3 | 3 | 3 | 3 | ..... | 5 |
| 4 | Wholesale store | 50 | ..... | 30 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | ..... | 5 |
| 2 | Office buildings | 60 | ... | 40 | 15 | 15 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 5 | 5 | 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | ..... | 3 |
| 67 | Residences | 1,035 | ..... | 150 | 200 | 250 | 250 | 275 | 275 | 300 | 275 | 275 | 200 | 200 | 100 | 100 | 25 | 25 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | ..... | 75 |
| 1 | Depot | 20 | ..... | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 10 | 10 | 10 | 10 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | ..... | 10 |
| 1 | Lodge hall | 40 | ..... | ..... | ..... | ..... | 10 | 10 | 40 | 40 | 40 | 40 | 40 | 40 | 5 | 5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Court house and jail | 40 | ..... | 20 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 14 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | ..... | 4 |
| 2 | Engine houses | 35 | ..... | ..... | ..... | 5 | 15 | 15 | 15 | 15 | 15 | 15 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | ..... | 2 |
| 2 | Churches | 65 | ..... | ..... | 5 | 5 | 50 | 50 | 50 | 50 | 30 | 30 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 3 | Hotels | 825 | .... | 218 | 266 | 434 | 368 | 528 | 405 | 485 | 384 | 464 | 275 | 355 | 144 | 224 | 83 | 123 | 48 | 64 | 39 | 47 | 31 | 31 | 31 | 31 | 49 | 49 | ..... | 127 |
| 1 | Theatre | 300 | ..... | 5 | 10 | 10 | 100 | 100 | 250 | 250 | 250 | 250 | 200 | 200 | 50 | 50 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Post office | 20 | ..... | 20 | 10 | 10 | 10 | 10 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | ... | 2 |
| | Totals | ..... | ..... | 1,091 | 1,081 | 1,364 | 1,435 | 1,725 | 1,564 | 1,669 | 1,326 | 1,406 | 937 | 1,017 | 471 | 351 | 229 | 269 | 149 | 165 | 145 | 143 | 125 | 125 | 125 | 125 | 157 | 157 | ..... | 364 |

prepared for summer and winter and for the average day, and from these tables output curves have been constructed showing the results graphically. Total output curves show the conditions for which the output must be designed.

Table I. gives the output as above stated. The first column gives the character of place, the number of lights of 16 c. p. in same, and the total number of lights in such class. The following column gives the hours of use and the number in use in summer and winter, under the headings "S" and "W," respectively. The three hotels are treated in detail in Table II., and the results summarized in Table I.

The solid lines of the diagrams show the winter load and the broken lines the summer load, which in most cases merge into the winter load after dark. As the diagrams are prepared from the tables, they do not show a gradual variation of load, but sudden changes; evidently this will not be the case in practice, but the load will be thrown on and off in a manner indicated by the curved line in the diagram for residences; the area included between the curved line and the base is, however, the same as between the broken line and the base, and therefore, deductions as to power, income, etc., are correct when taken from any of the diagrams.

Although the tables and diagrams plainly show the state of affairs for each class of customers, it may be well to dwell upon the salient points. Hotels, saloons, billiard rooms, drug stores and cigar stores are good customers for general merchandise; retail stores not so good, but fair; factories and wholesale stores, poor (for a station running from dusk to daylight); office buildings, for the same reason, poor; theatres and public buildings, good or bad, according to whether they are often used in the evening; churches, very poor. Considering these classes in somewhat more detail, we note that:

Hotels and clubs usually light liberally and run late; generally have a considerable number in dark places, kitchens and servants' quarters, which are used early and late. Lights are allowed to remain in use much more than necessity demands. The matter of lights in dark places must be considered when deciding upon the advisability of furnishing current during the day.

Saloons light liberally; on cloudy days use a considerable number in the daytime, as the windows are usually more or less screened, thereby shutting out daylight. The time of closing is, in some places—particularly for Saturday night and the night before election day—a legal matter. Most places have some all-night saloons. Saloons light up early in the morning to clean up, and on dark winter mornings, for business.

Billiard rooms are usually in hotels or saloons. Those not so located use lights about as if they were, except closing somewhat earlier.

Drug stores generally have a few lamps over prescription tables, in cellars and other dark places, which will be used all the time, if on contract, and a considerable time, if on meter. Generally light liberally and keep some all night lights.

Cigar stores generally keep open about as long as temperance billiard parlors, 9 to 10 p. m., and midnight on Saturdays.

Retail Stores.—The offices and some places for showing goods are usually dark, since the lighter parts of the store are given up to counters, show windows, etc. They usually keep open until 8 p. m., five nights a week, and 9 p. m. on Saturday (excepting the higher class stores in large cities), and light liberally per square foot of floor space, especially the windows. A few all night lights are usually run, and in winter from 6 to 7 a. m., some additional lights are turned on.

Wholesale Stores.—Usually the offices are near windows or under skylights, and lights are seldom used in summer, except for cellars and dark corners, because the stores close by 6. The warehouse portions are only sufficiently lighted to handle packages. A few night lights are used.

Office Buildings.—The rooms in office buildings in large cities are usually only used for office purposes and generally not after 6 p. m. In towns, however, they are often used in the evening and not infrequently are rented as bedrooms, or even in suites, for domestic purposes. In the town considered, they are supposed to be so used to some extent.

Lodge buildings are good, if used almost every night, and the same remark holds good for theatres and public buildings. The extent of probable use is shown in the table.

Residences have a large number of lights installed, as compared with those in operation. It also generally costs twice as much for copper to reach them.

Churches burn the full number only on Sunday evenings—which is not objectionable—and usually a few two

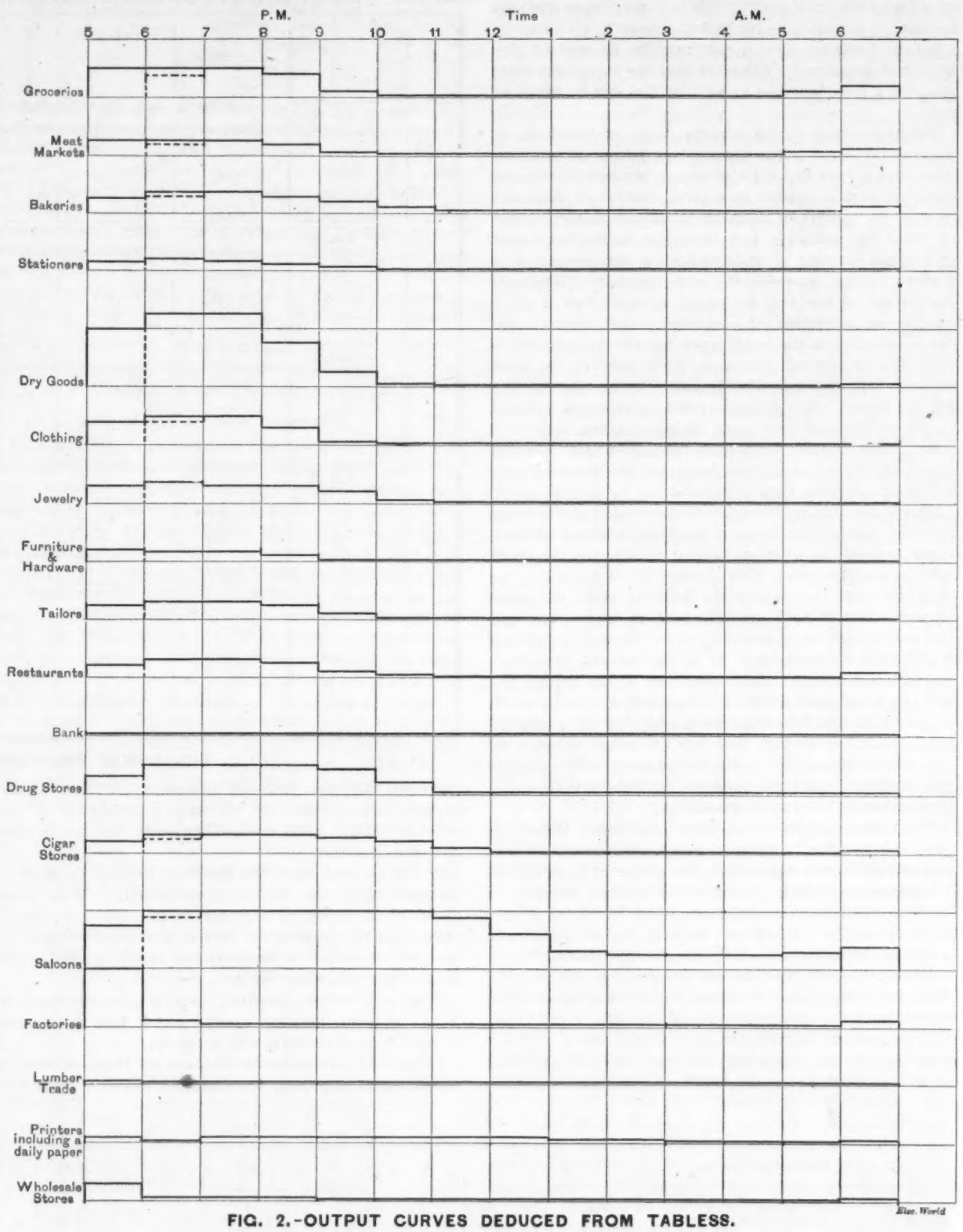
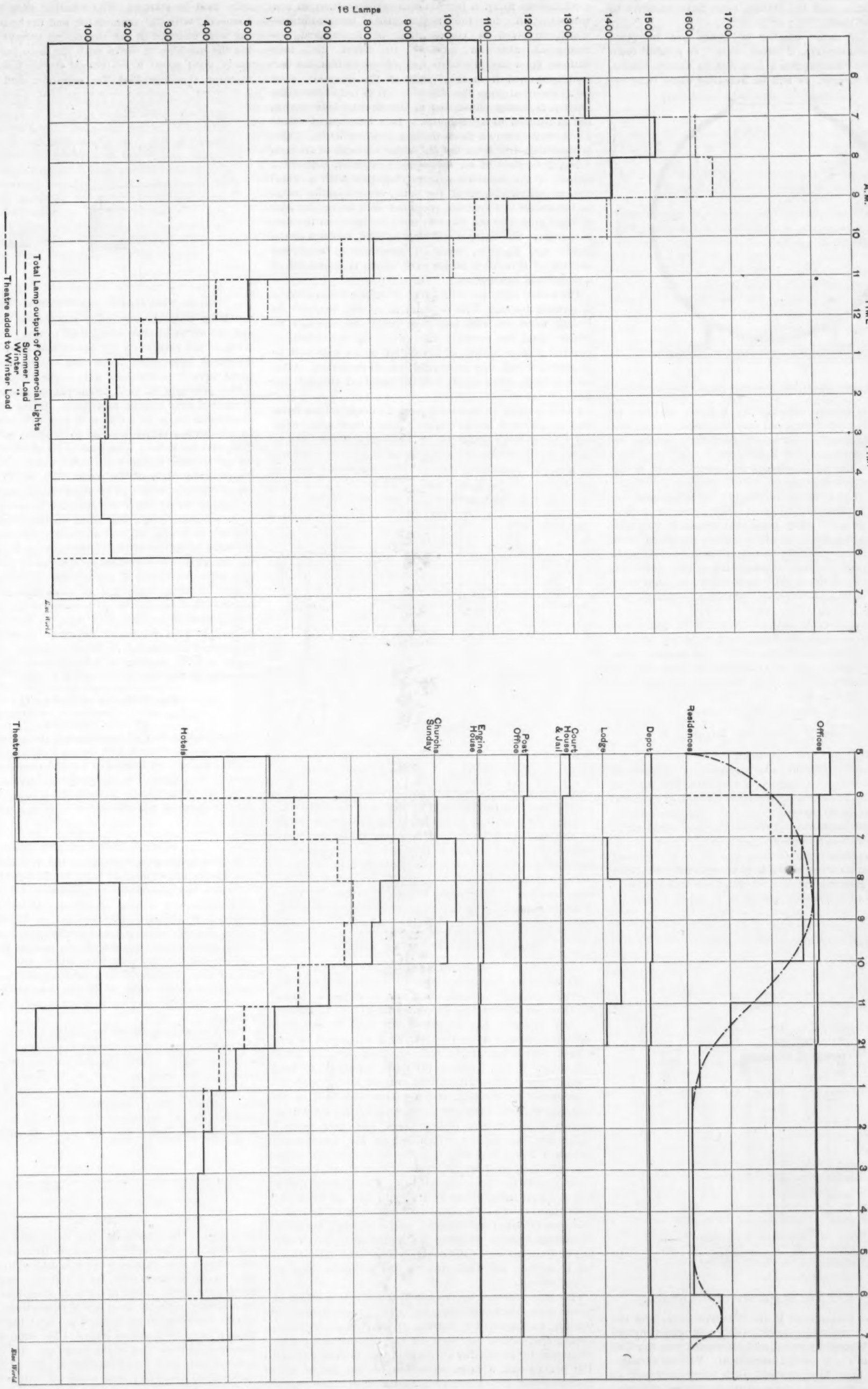



FIG. 2.—OUTPUT CURVES DEDUCED FROM TABLESS.

TABLE II.

| Second class hotel, 300. | | 5-6. | | 6-7. | | 7-8. | | 8-9. | | 9-10. | | 10-11. | | 11-12. | | 12-1. | | 1-2. | | 2-3. | | 3-4. | | 4-5. | | 5-6. | | 6 7. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. | S. | W | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. | S. | W. |
| Dining room | 15 | .... | 15 | 12 | 15 | 15 | 15 | 4 | 4 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 4 |
| Office | 5 | .... | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | .... | 1 |
| Reading room | 3 | .... | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 |
| Billiard room | 12 | .... | 6 | 6 | 6 | 12 | 12 | 12 | 12 | 12 | 12 | 9 | 9 | 6 | 6 | 4 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | .... | 4 |
| Bar room | 8 | .... | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 4 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 4 | .... | 4 |
| Kitchen cellars | 15 | .... | 12 | 12 | 12 | 12 | 12 | 9 | 9 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | .... | 6 |
| Parlors | 5 | .... | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Halls | 15 | .... | 7 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 7 | 7 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | .... | 7 |
| Sample rooms | 5 | .... | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Rooms | 217 | .... | 15 | 30 | 90 | 60 | 120 | 90 | 120 | 90 | 120 | 60 | 90 | 30 | 60 | 15 | 30 | 9 | 15 | 6 | 9 | 3 | 3 | 3 | 3 | 3 | 3 | .... | 15 |
| Total | 300 | ... | 77 | 92 | 155 | 131 | 191 | 147 | 177 | 137 | 167 | 98 | 128 | 54 | 84 | 30 | 45 | 16 | 22 | 13 | 16 | 10 | 10 | 10 | 10 | 15 | 15 | .... | 42 |
| **Third class hotel, 25.** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dining room | 8 | .... | 4 | 8 | 8 | 6 | 6 | 2 | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | 1 | .... | 8 |
| Office | 3 | .... | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | .... | 2 |
| Billiard and bar | 8 | .... | 4 | 6 | 6 | 8 | 8 | 8 | 8 | 8 | 8 | 6 | 6 | 4 | 4 | 4 | 4 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | .... | 4 |
| Parlor | 2 | .... | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Halls | 4 | .... | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | .... | 4 |
| Total | 25 | ... | 14 | 22 | 22 | 22 | 22 | 18 | 18 | 16 | 16 | 14 | 14 | 7 | 7 | 7 | 7 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 7 | 7 | .... | 18 |
| **First class hotel, 500.** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dining room | 20 | .... | 20 | 15 | 20 | 20 | 20 | 5 | 5 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 5 |
| Office | 10 | .... | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | .... | 5 |
| Reading room | 5 | .... | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 |
| Billiard room | 15 | .... | 7 | 7 | 7 | 15 | 15 | 15 | 15 | 15 | 15 | 11 | 11 | 7 | 7 | 5 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 5 | 5 | .... | 5 |
| Bar room | 10 | .... | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 5 | 5 | .... | 5 |
| Barber shop | 10 | .... | 10 | 10 | 10 | 10 | 10 | 5 | 5 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 |
| Kitchen and cellars | 25 | .... | 20 | 20 | 20 | 20 | 20 | 15 | 15 | 15 | 15 | 10 | 10 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 5 | 5 | .... | 10 |
| Parlors | 10 | . | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Halls | 20 | .... | 10 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 10 | 10 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | .... | 10 |
| Sample rooms | 10 | .... | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Rooms | 305 | .... | 25 | 50 | 150 | 100 | 200 | 150 | 200 | 150 | 200 | 100 | 15 0 | 50 | 100 | 25 | 50 | 15 | 25 | 10 | 15 | 5 | 5 | 5 | 5 | 5 | 5 | .... | 25 |
| Total | 500 | .... | 127 | 152 | 257 | 215 | 315 | 240 | 290 | 231 | 281 | 163 | 213 | 83 | 133 | 46 | 71 | 27 | 37 | 22 | 27 | 17 | 17 | 17 | 17 | 27 | 27 | .. | 67 |
| Second class | | .... | 77 | 92 | 155 | 131 | 191 | 147 | 177 | 137 | 167 | 98 | 128 | 54 | 84 | 30 | 45 | 16 | 22 | 13 | 16 | 10 | 10 | 10 | 10 | 15 | 15 | .... | 42 |
| Third class | | .... | 14 | 22 | 22 | 22 | 22 | 18 | 18 | 16 | 16 | 14 | 14 | 7 | 7 | 7 | 7 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 7 | 7 | ... | 18 |
| Total hotels | | .... | 218 | 266 | 434 | 368 | 528 | 405 | 485 | 384 | 464 | 275 | 355 | 144 | 224 | 83 | 123 | 48 | 64 | 3 9 | 47 | 31 | 31 | 31 | 31 | 49 | 49 | .... | 127 |




FIGS. 3 AND 4.—OUTPUT CURVES DEDUCED FROM TABLES.

or three evenings a week. Unfortunately, they may burn all on some evenings when there is a heavy load, as on a Saturday evening with the theatre going, especially before Christmas, and the station must have capacity to take care of them.

Theatres.—A large number of lights are in place and are remunerative, if often used. In a small town the residence consumption is lessened on theatre nights.

It is well to note, as will be hereafter more fully explained, that station capacity for a large number of lights seldom used means not only increased capital, but generally increased expense of operation, because of normally operating under a light load. In the above connection might be considered all special lights, which are installed for reasons of policy, pride, etc. Sometimes they are in large quantities, are not often used and the income is irregular; in short, they generally do not, in themselves, pay. They must be considered, however, when estimating the capacity required, as, when used, it is generally at the time of the greatest output, when the city is full of visitors, or something of that character, and the hotels, theatres, clubs and stores are using every light. Lights in State capitols, exhibition buildings, etc., belong to this class.

Street Lights.—It is seldom advisable to run street lights on the commercial lines, as it is better to have special circuits and turn on and off from the station. Also the pounds of copper per lamp and energy wasted in the line are usually less in systems for street lighting than for commercial lighting.

*(To be continued.)*

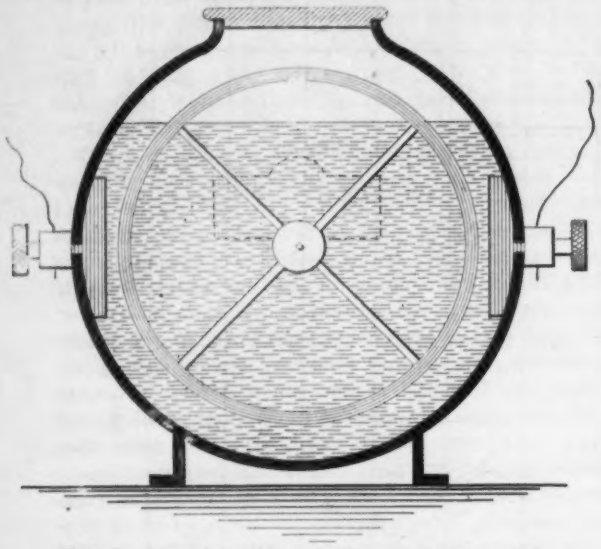


Fig. 1.—Suggestions for Metering Devices.

## Suggestions for Metering Devices.—V.

BY S. D. MOTT.

The passing of a current to be measured, or a fractional part thereof, through a solution of a metallic salt, and the current strength calculated from the amount of chemical action taking place therein, is undoubtedly, theoretically considered, as accurate a principle for the measuring of currents as is known to electro-technics.

Electrolytic deposition being governed by exact laws, we know that a certain strength of current will carry over and deposit a certain amount of metal per unit of time.

This type of apparatus complete in itself, commonly known as the voltameter, in its primitive form, was the first used for scientific investigation and experimental purposes in laboratory work, and afterward was the first in the field as a commercial instrument. Various arrangements of it have been devised, care being exercised in all cases to reduce to a minimum the modifying elements of its accurate working, viz., temperature of environment, and when direct reading is desired, the more disturbing element of mechanical friction. In 1880, while engaged in laboratory work, the writer devised the type of electro-chemical meter shown in Fig. 1. The idea was to get a continuous rotation by chemical decomposition, in contradistinction to the reciprocating beam-balance—which involved a complication of mechanical elements—as also an advance to direct dial indications, from the primitive way of calculating the current consumed from the weight of the elements, after being removed from the solution. It is not claimed the friction is wholly eliminated in the devices here shown, but is reduced to a minimum. In a subsequent article I hope to illustrate a direct reading chemical meter, which is absolutely free from the disturbing element of friction.

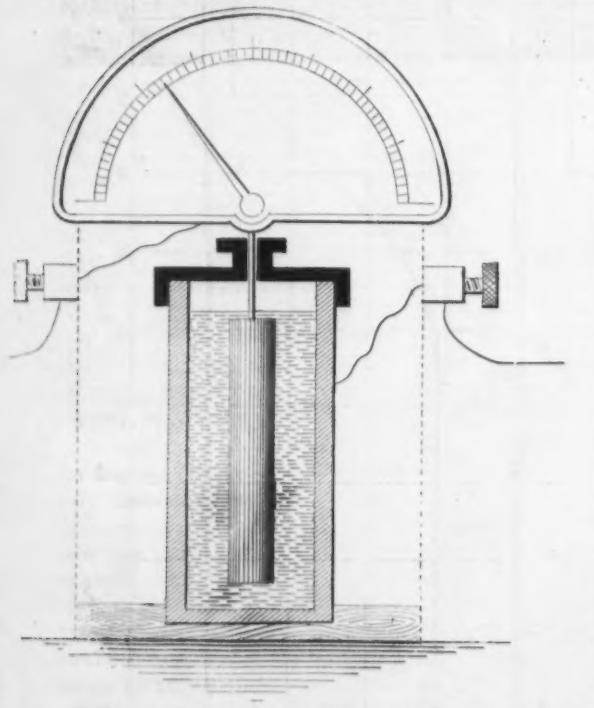


Fig. 2.—Suggestions for Metering Devices.

Fig. 2 consists of an insulating receptacle, containing copper or zinc sulphate solution, together with a wheel disc or hollow sphere of the same electrolyzable metal as the anode and kathode, mounted on a horizontal axis at right angles to the shortest distance between the two electrodes. The bath, it will thus be seen, consists of the anode and kathode, with an intermediate conductor capable of revolution on an axis, which is connected to a registering mechanism.

The action upon the wheel disc or sphere when current is passing through it is to build it up and increase its weight upon one side and take from and diminish its weight upon the opposite side, when, by the action of gravity, a slow motion of revolution on its axis will be imparted, which may be intermittent in its action. After each reading the current may be reversed through the cell.

I have frequently wondered, and, no doubt others have, why the plates of an electrometer cannot be weighed without removal from apparatus on some such simple plan as Fig. 3. This consists of a zinc solution in a vessel composed of metallic zinc and a zinc cylinder suspended therein, the latter composing the anode and kathode of a bath, the suspended element being connected to a spring or other form of weighing balance. The current, in this case, after each reading, will be reversed through cell.

When the receptacle is the anode the increase in weight of the suspended kathode determines the current consumed; when the current is reversed and the receptacle becomes the kathode, then the diminution in weight of suspended zinc becomes the visible indication of current consumed. The scale, instead of indicating variations in weight, marks ampere-hours or other arbitrary units.

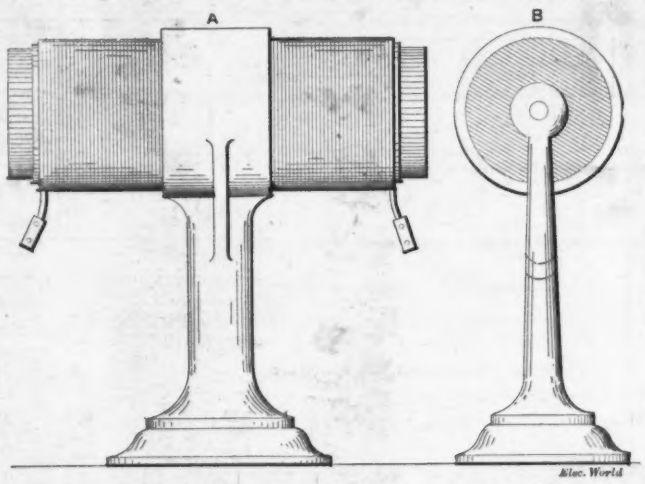



Illustration of Principle of Single Phase Motors.

## Single Phase Alternating Motors.

BY ELIHU THOMSON.

My attention has been called to an article appearing in your valuable journal, on "Non-synchronous Motor for Ordinary Alternating Currents,"* by C. E. L. Brown.

I beg to state that motors of the kind he describes were not unknown to the art, as a reference to my United States patent No. 407,844, filed Nov. 17, 1888, will show. In fact I sent to the Paris Exposition of 1889 a small single-phase alternating current motor with arrangements for starting, which motor was built in accordance with the principle pointed out by Mr. Brown, as arising from his own observations. Not long after I made my experiments which led to the transformer motors I found that such a motor could have its armature coils kept on short circuit and run in either direction after a start had been given to it. The original motor had a single inducing or field circuit, and an armature with three coils and a commutator, similar to that of a Thomson-Houston arc machine, and connected, movable, straddling brushes whereby the period of short circuiting of the armature coils could be increased after starting to include the whole period, and maintain them on closed circuit.

This was followed by the construction and working of many such machines with different arrangements of winding and means for starting. I have no hesitation in saying that had it not been for the comparatively high frequency of alternating currents in use, namely 125 and 130 per second, a large extension of the use of such motors would have taken place by this time in the United States.

The motor on this principle which was exhibited at Paris in 1889 was described in a number of the technical journals at the time. It had a commutator which was only used in starting. The rotating part had its coils connected with the commutator, and the brushes at starting were included in the alternating current circuit driving the machine in series with the inducing field. At a fairly good speed a centrifugal device inside the commutator short-circuited the segments and placed the revolving coils thereby on a maintained short circuit, and the motor at once speeded up to nearly synchronism. Even at 125 periodicity the motor was efficient, the only drawback being that its weight output was less than could have been obtained with lower frequency.

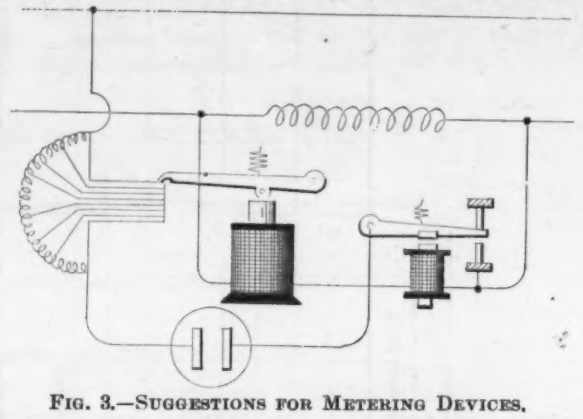


Fig. 3.—Suggestions for Metering Devices.

The principle of such single-phase motors may be illustrated very prettily as follows: In the accompanying illustration let A be a coil with iron-wire core energized by alternating currents so as to produce an alternating field, and let B be a wheel made up of iron discs at the centre, around which is a rim or band of copper overhanging the edges of the discs. This wheel is mounted on pivots and started in rotation mechanically in either direction. After this it will increase in speed and torque up to a certain point, depending on the frequency of the currents in A and the friction to be overcome. That the direction of motion is indifferent may be shown by turning the wheel on a vertical axis so as to present to the pole the opposite end of a diameter. The rotative action I have formerly described as being due to translation lag, that is, a lag due to the traverse of a conductor conveying current past the pole, whereby the action of the current in that conductor becomes displaced in the direction of motion and produces a moving field, the iron mass or body tending to accommodate itself to the direction of the lines in the moving field.

## The Diffusion of Light.—II.*

BY W. E. SUMPNER.

A convenient way of ascertaining the reflecting power of a diffusing surface is to compare it directly with that of blotting paper. If, instead of the Methven standard at L (see Fig. 1), a sheet of blotting paper, of area A′, be erected at the end of the bench opposite the screen O R, the reflecting power of the surface of O R is given by the formula

$$r = 0.82 \frac{x^4 A'}{y^4 A}.$$

This method has the advantage that it is independent of any fluctuation which may occur in the light K.

There is one remarkable peculiarity of a diffusive reflector which is well worthy of notice. An ordinary mirror reflects light almost equally well for all directions of incidence, and where any difference exists it is found that rays which make a large angle with the normal to the surface suffer less absorption than those which are nearly perpendicular to it. With a diffusive reflector, on the other hand, the light is mostly sent off in the normal direction, and, however the light may be incident upon the surface, it is diffused.

This can easily be shown by placing immediately behind a glow lamp first a piece of common mirror, and secondly a sheet of white paper. In the former case the candle power of the lamp is found to be nearly doubled, but in the latter case it is far more than doubled. In the former case, however, the candle power is doubled in all directions on one side of the mirror, while in the latter the statement is only true for directions in the neighborhood of the normal to the paper reflector. A plane white reflector is therefore more efficient than a plane mirror when it is desired to increase the light in one direction only, for it reflects about twice as much light as the mirror in different directions in accordance with a perfectly fixed law of proportions. A common mirror reflecting 80 per cent. of the light incident upon it from a lamp, produces an image of the lamp whose candle power is 0.8 time that of the lamp, and this candle power is nearly the same for all directions. But a piece of white paper illuminated by a lamp sends off most of its rays in the normal direction, and, although its reflecting power

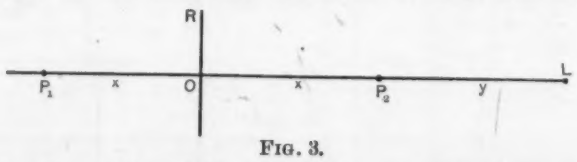



Fig. 3.

* See The Electrical World, Feb. 25, 1893, p. 138.

* From the London *Electrician*. For the first section of this article see The Electrical World, March 18, 1893, page 205.

may not exceed 80 per cent., it is quite possible for a white reflector to more than double the candle po er of the lamp for a particular direction.

MEASUREMENT OF ABSORPTION.

The absorbing powers of some of the preceding substances were determined by measuring the candle power of the light from a glow lamp, first when this was uncovered, and afterward when it was surrounded with a cylinder of the paper under test. The cylinders were short. being just longer than the height of the lamp, and were closed at top and bottom with caps of the same paper, so that the lamp was completely enveloped by the paper tested. The ratio of the diminution of candle power to the original candle power gave the apparent absorption of the paper. If the candle power in some particular case was found to diminish 30 per cent., it would have been erroneous to conclude that the envelope absorbed as much as 30 per cent. of the light incident upon it, or that 70 per cent. was transmitted. If the reflecting, absorbing and transmitting powers of a material be respectively denoted by r, a and t, there must exist between these quantities the relation

$$r + a + t = 1.$$

Also if Q be the quantity of light given out per second by the light source within the envelope, the quantity of light incident per second upon the surface of the envelope will, owing to internal reflection, be increased to Q′, where

$$Q'(1 - r) = Q;$$

the quantity of light absorbed and transmitted will respectively be

$$a\,Q' \text{ and } t\,Q',$$

and the ratios these quantities bear to Q will similarly be

$$a \div (1 - r) \text{ and } t \div (1 - r);$$

the sum, of course, being unity.

If the light source can be assumed to radiate equally in all directions, the ratio of its candle power, after putting on the envelope, to the original candle power will not be t, but $t \div (1 - r)$. The influence of internal reflection is to increase both the absorption and the transmission, and unless it is taken into account large errors may be made in estimating coefficients. A very simply way of showing the effect of internal reflection consists in surrounding a glow lamp with a white paper cylinder, open at he top, and adjusting a photometer screen till the illumin ·ion caused by it is balanced against that of some standard s ırce of light. If now a piece of white paper be placed on th top of the cylinder, so as to shut in the vertical rays of the lamp, the candle-power in the horizontal direction will be found to increase considerably. In some of the tests, in order to avoid error caused by non-uniform radiation of the lamp, this was first surrounded with an envelope of tracing cloth, or blotting paper, and the combination used as the light source. If $k_0$ be its candle power in this condition, and if $k_1$ be the observed candle power after completely surrounding it with an envelope of the substance to be tested, the apparent absorption of this is

$$\frac{k_0 - k_1}{k_0},$$

and the true absorption coefficient a is given by

$$a = (1 - r)\frac{k_0 - k_1}{k_0},$$

where r is the previously found reflection coefficient.

The following table gives the values of the absorbing coefficients, expressed as percentages, for the four substances at the head of Table I.:

TABLE IV.

| —— | Apparent absorption. | Absorption coefficient. |
|---|---|---|
| White blotting paper | 77 per cent. | 13.8 per cent. |
| White cartridge paper | 61 " | 12.2 " |
| Tracing cloth | 23 " | 15.0 " |
| Tracing paper | 9 " | 7.0 " |

Three large glass globes, made for arc lamps, were also tested. As the reflective powers of the globes could not easily be found, only the apparent absortion was measured. One globe was of opal glass (almost transparent), and the ratio of apparent absorption was 15 per cent. A second globe was of ground glass and absorbed 42 per cent. The remaining one was of opal glass, too opaque to allow any bright object placed within it to be distinguished. This absorbed 39 per cent.

MEASUREMENTS OF TRANSMITTING POWER.

The amount of light transmitted through the surfaces above mentioned was measured in a very similar manner to that in which their reflective powers were determined; the only difference being that the glow lamp at $P_1$ (see Fig. 1) was moved to the opposite side of the surface as in Fig. 3.

O R represents the screen of paper, pinned on a wooden frame, and placed perpendicular to the optical bench $P_1$ L. The glow lamp was at $P_1$, the photometer at $P_2$, and the Methven standard at L In all the tests the distances $O P_1$, $O P_2$ were arranged to be equal, and balance was obtained by moving L along the bench. It can then be shown that the formula already given for reflection holds equally well for transmission, and with the same notation as before we have

$$t = \frac{L}{K}\frac{x^2}{y^2}\left\{\frac{\pi x^2}{A} + 1.75\right\},$$

it being the coefficient of transmission, assuming that all the light transmitted is diffused. It was found, however, that all the four substances tested were more or less transparent, so that while a portion, $t_1$, of the incident light was scattered in accordance with the law of diffusion, another part, $t_2$, was transmitted without change of direction. This must obviously be the case with substances like thin opal glass, which are sufficiently transparent to enable the eye to clearly distinguish objects through them, and it seems only natural for it to be true of translucent surfaces, which, when placed between the eye and the light, appear brightest just where the surface is cut by the straight line joining the light to the eye. The result, however, appears true for nearly all surfaces which transmit light at all, and even thick blotting paper transmits nearly 3 per cent. of the incident light without any change of direction.

In order to separate the effects of diffused and regular transmission it became necessary, as before, to make measurements for several values of the distance x. The coefficients $t_1$ and $t_2$ are connected by the equation

$$\frac{L}{K}\frac{x^2}{y^2}\left\{\frac{\pi x^2}{A} + 1.75\right\} = t_1 + \frac{t^2}{4}\left\{\frac{\pi x^2}{A} + 1.75\right\},$$

and, as before, by plotting a curve connecting the observed values of Y and X, where

$$Y = \frac{L}{K}\frac{x^2}{y^2}X,$$

and

$$X = \frac{\pi x^2}{A} + 1.75,$$

the values of $t_1$ and $t_2$ were found. The numbers given in Tables V. and VI. indicate the nature of the results obtained, and the general agreement of the experimental numbers with those calculated from the formulæ. The observations are plotted in Fig. 2, and the results are summarized in Table VII.

In Table VIII. the reflecting, absorbing, and transmitting coefficients have been collected, and the sum of these quantities is given in the last column. This sum should be unity, or 100 per cent. The excess above the theoretical value is probably due to a slight difference between the actual law of diffusion and that which is generally assumed to hold. The formulæ used above have been obtained on the assumption that a diffusing surface scatters its light in different directions with an intensity proportional to the cosine of the angle which the direction considered makes with the normal to the surface. A very slight divergence from this law would be amply sufficient to account for the small discrepancies shown in the last column of Table VIII.

TABLE V.—TRANSMITTING POWER OF BLOTTING PAPER.

A = 980. K = 26. L = 2. t = 9.2 Ycalc. = 6.50 + 2.7 X ÷ 4.

| | | | | | | |
|---|---|---|---|---|---|---|
| r | 60 | 50 | 40 | 45 | 55 | 60 |
| y | 154 | 120 | 88.4 | 101.6 | 137 | 154 |
| X | 13.6 | 9.8 | 7.0 | 8.25 | 11.40 | 13.6 |
| Yobs | 15.5 | 13.2 | 11.2 | 12.0 | 14.4 | 15.5 |
| Ycalc. | 15.7 | 13.1 | 11.2 | 12.1 | 14.2 | 15.7 |

TABLE VI.—TRANSMITTING POWER OF TRACING CLOTH.

A = 980. K = 23.1. L = 2. t = 54.4. Ycalc. = 41.0 + 13.4 X ÷ 4.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| x | 40 | 50 | 60 | 70 | 80 | 75 | 65 | 55 | 45 |
| y | 39.2 | 53.5 | 70.1 | 89.4 | 105.6 | 95.8 | 77.7 | 61 | 46.1 |
| X | 6.98 | 9.80 | 13.6 | 17.4 | 22.30 | 19.4 | 15.4 | 11.2 | 8.25 |
| Yobs | 63.5 | 74.3 | 86.1 | 97.0 | 116 | 107 | 91.8 | 81.7 | 69.3 |
| Ycalc | 64.4 | 73.7 | 85.6 | 99.2 | 115.8 | 106 | 91.0 | 78.5 | 68.7 |

TABLE VII.—TRANSMITTING POWERS.

| | Diffused $t_1$ | Direct $t_2$ | Total t |
|---|---|---|---|
| Blotting paper | 6.5 per cent. | 2.7 per cent. | 9.2 per cent. |
| Cartridge paper | 8.7 " | 2.5 " | 11.2 " |
| Tracing cloth | 41.0 " | 13.4 " | 54.4 " |
| Tracing paper | 46.0 " | 29.8 " | 76.0 " |

TABLE VIII.

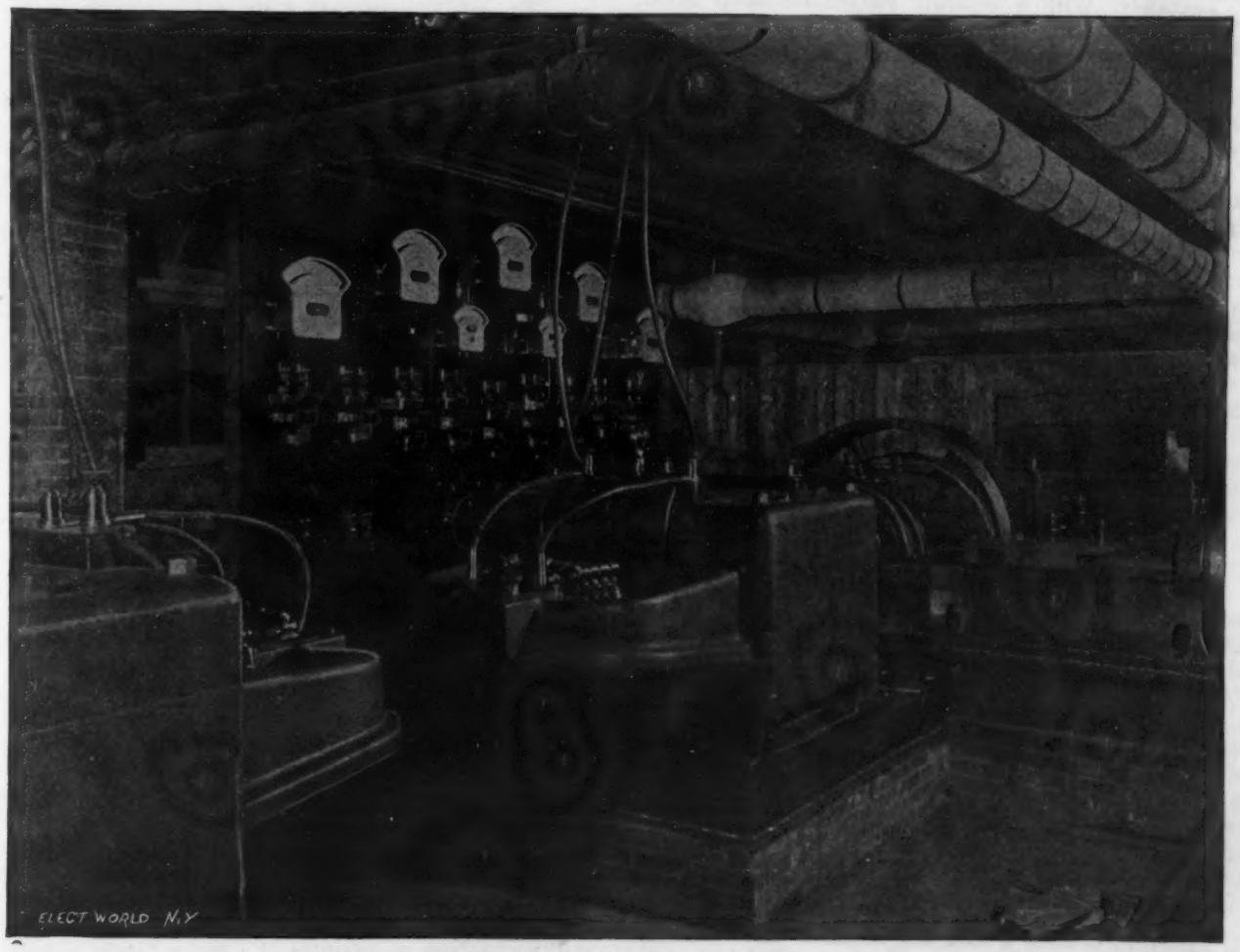
| | Reflection. r | Absorption. a | Transmission. t | r+a+t |
|---|---|---|---|---|
| Blotting paper | 82 per cent. | 13.8 per cent. | 9.2 per cent. | 105.0 p. c. |
| Cartridge paper | 80 " | 12.2 " | 11.2 " | 103.4 " |
| Tracing cloth | 35 " | 15.0 " | 54.4 " | 104.4 " |
| Tracing paper | 22 " | 7.0 " | 76.0 " | 105.0 " |

## A Modern Isolated Plant.

The electric lighting plant of the Havemeyer Building, in this city, which has recently gone into operation, contains all the most recent developments in incandescent electric lighting for isolated plants.

The plant is one of 3,000 lights. There are four McIntosh & Seymour engines, three of which are 65 h. p., and directly coupled upon the shaft of each of these is an Eickemeyer dynamo of 40 kw. The fourth engine is 20 h. p., and an entirely new and very interesting rope drive connects the engine to an Eickemeyer dynamo of 12 kw. This small engine and dynamo is for use during periods of light load.

The switchboard is of polished, jet black, marbleized slate, and mounted on this are the voltmeters, ampere meters, main line switches, rheostats, ground detector and multiple switch for reading the E. M. F. at various points in the building. The rheostats are those of the Carpenter Enamel Rheostat Company, and they present a very handsome appearance, while occupying a small space. The voltmeters and ampere meters are of the Weston make, and are of the central station type with illuminated dials, having been made specially for the contractors for use in this particular plant.




A MODERN ISOLATED PLANT.

There are 14 Ajax switches upon the switchboard, one for connecting the entire building upon the mains of the three-wire central station of the Edison company, one for each dynamo, eight for the office lights of the various floors, and one for the hall lights.

The entire plant was installed by H. Ward Leonard & Co., under the supervision of Mr. Frank A. Pattison, the consulting electrical engineer of the architect, Geo. B. Post. Promptly upon completion the entire plant was subjected to an exhaustive test by Mr. Pattison, lasting two days. The dynamos were subjected to a full load test of ten hours, and operated very perfectly in every way. The rise in temperature was 100 degrees F. at the end of the ten hours' run. Indicator diagrams from the various engines showed a very perfect steam distribution and very close governing. The insulation of the system of conductors was extremely high, being 160,000 ohms with everything in circuit. The plant was immediately passed by the fire underwriters and accepted by the owners.

It is a matter of interest to note that the floor space occupied by the entire plant, including the space between the dynamos and surrounding them, is only five square feet per kilowatt.

# THE ELECTRICAL WORLD'S DIGEST

OF

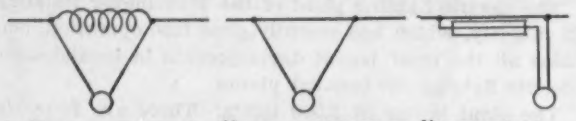
# CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

## ELECTRO-PHYSICS.

*High Frequency Phenomena.*—Mr. Janet, before the French Society of Physics, made the following experiments with an incandescent lamp: Fig. 1 shows an incandescent lamp shunted with a few turns of copper wire and connected to a source of high frequency current; as is well known the lamp in this case will burn



FIGS. 1, 2 AND 3.—HIGH FREQUENCY PHENOMENA.

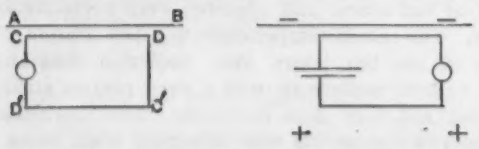
brightly; the phenomena appeared explicable either by the self-induction of the coil or by an actual increase in its resistance; he thinks, however, that the effect should be attributed to mutual induction. To show this he first replaced the spiral by a small rod of copper, as in Fig. 2, and found that the lamp will also burn; he next placed one of the wires of the lamp circuit parallel to the principal circuit, as shown in Fig. 3, insulating it with a glass tube, in which case the lamp went out immediately. With a separate rectangular lamp circuit brought near the principal circuit, as shown in Fig. 4, the lamp lights up. If the circuits are arranged as in Fig. 5, with a condenser in the lamp circuit, the lamps brighten if the conditions are suitable. In the latter case he finds that if there is a variable inductance in the lamp circuit, the capacity being fixed and inferior to a certain value, the brilliancy of the lamp attains a clearly marked maximum, for a certain value of the self-induction, which value occurs when the periods of the two circuits are equal. If the capacity of the primary circuit is altered it is found that in order to obtain the maximum brilliancy, either the capacity or induction of the secondary circuit must be similarily altered. The article is described in "La. Lum. Elec." and abstracted in the Lond. "Elec.," March 3.

*Electrostatic Motor.*—The article abstracted in the Digest, Feb. 4, p. 88, is contained in full in the Lond. "Elec.," March 3, including cuts showing the motor and the electrical arrangements to obtain the rotating field. In commenting on this phenomenon, the Lond. "Electrician" states that the phenomena of residual absorption in condensers may in many ways be compared with that of residual magnetism, with the important difference, however, that the former depends on time, while the latter is independent of it; the waste of energy due to magnetic hysteresis is independent of the frequency, but no one has yet shown that the loss in the dielectric of a condenser depends only on the amount of charge. It does not agree with Mr. Arno that the rotation of the armature of his motor is caused by the lag of the polarization of the cylinder behind the rotation of the electric field causing it.

*Magnetic Storms.*—Lord Kelvin (Sir Wm. Thomson) before the Royal Society stated that he thought terrestrial magnetic storms were not due to sun spots, because to produce a moderate magnetic disturbance for only a few hours the sun would have to emit as much energy into space as it ordinarily does in four months in its emission of light and heat.

## UNITS, MEASUREMENTS AND INSTRUMENTS.

*Condensers.*—Mr. Korda, in the "Elek. Zeitschrift," Feb. 10, gives a somewhat extended theoretical discussion of a condenser placed in the secondary circuit of a transformer instead of being placed directly in the circuit. It is of a purely theoretical character. Among his conclusions are the following: There is a certain value for the capacity, for which the reaction of the secondary current of a transformer on the value of the apparent resistance in the primary circuit, is annulled, so that the reaction manifests itself only in the change (of the direction) of the phase difference of the permanent current. He also states that there are two values for the capacity for which, owing to the reaction, the phase of the E. M. F. and the primary current will coincide; that is, the zero point of the two curves will be the same, the current, however, will by no means follow Ohm's




FIGS. 4 AND 5.—HIGH FREQUENCY PHENOMENA.

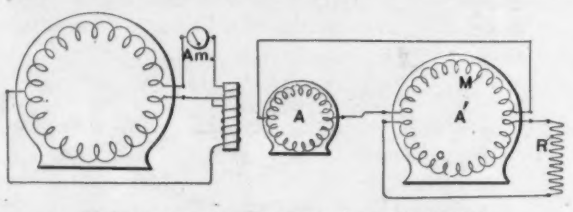
law. The conditions, however, may be made so that the results will approximate very closely to Ohm's law; this is accomplished with the aid of a very much smaller capacity than when the influence of the self-induction is to be balanced by a condenser connected directly in the circuit. When the rest of the primary circuit contains no self-induction he compares the capacity of a condenser connected directly in circuit with that of a condenser in the secondary circuit of a transformer, and finds that the latter becomes smaller approximately in the proportion of twice the square of the number of windings in the primary to the square of the number of windings in the secondary.

*Kelvin Wattmeter.*—Referring to the suggestion of Dr. Fleming, mentioned last week, for using a transformer instead of a non-inductive resistance, Mr. Meikle writes to the Lond. "Elec." that the advantages are by no means obvious. The current in the shunt coil is so small that the making of a non-inductive platinoid resistance is a comparatively simple and cheap matter. Even if a transformer were used it would still be necessary to have a large non-inductive resistance, as otherwise the inductance error and the temperature error would both be serious and difficult to estimate. Unless the moving parts of an instrument on a high tension circuit are at the same potential as the surrounding metal, large errors may be introduced, due to electrostatic attraction. In this instrument it was found necessary to have the movable coils in direct metallic contact with the scale and supports.

*Practical Formula.*—Prof. Forbes, in the Lond. "Elec.," corrects a statement which we abstracted in the issue of March 4, p. 160. When a current density differing from 1,000 is used, the result obtained from the rule must be multiplied by the square of the current density, and divided by the square of 1,000. He also adds the following rule: The double conductor of a circuit at a current density of 1,000 absorbs 5 volts per thousand yards, or about 90 volts per mile; the voltages lost vary directly as the current density.

## DYNAMOS, MOTORS AND TRANSFORMERS.

*Testing Alternators.*—In the Digest last week, p. 211, is described Mr. Mordey's method for testing alternators




FIGS. 1 AND 2.—TESTING ALTERNATORS.

using a modified Hopkinson method. The last number of the Lond. "Elec.," March 11, gives the first part of Mr. Mordey's paper in full. From this are taken the following cuts, Figs. 1 and 2, which should be used in connection with the description given last week. In his paper he gives a short description of Hopkinson's method, stating that he did not think advantage was taken of it as often as it should be. He describes the use of Hopkinson's method in connection with testing dynamotors (continuous current transformers) by coupling the armatures of two dynamos together, high pressure to high pressure and low pressure to low pressure, supplying only power enough to cover the losses.

A modification of the method shown in Fig. 2 is to regulate the power given by the portion G back to the circuit of A to M instead of wasting it in the resistance R. This may be done by putting one winding of a transformer of suitable size in place of the resistance R, and a second winding of the transformer in the circuit between A and M; the transformer must be capable of allowing a sufficient current to pass through one winding alone to run the machine as a motor lightly loaded; the portion M will then be traversed by a current larger

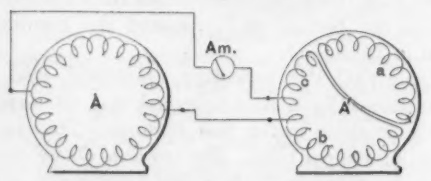



FIG. 3.—TESTING ALTERNATORS.

than that produced by G, otherwise it will not run as a motor.

Another method, which has the advantage of being a complete electrical method, is shown in Fig. 3. The armature of the machine to be tested is divided into three portions, a, b, c, the portions a and b being connected so as to neutralize each other as far as E. M. F. and power are concerned; it is then run up to synchronism with the generator A, after which the belt is thrown off. A runs as a motor by virtue of the power of c; the full working current may be forced through the whole armature, and all the conditions of full load will be observed with the exception that the torque will not be in the same sense all around the armature, which, however, does not interfere with the accuracy and value of the test. A single wattmeter reading taken at the terminals will then give the whole power expended, care being taken to allow for the exciting current. He also suggests other methods; a portion of the armature may be separated from the rest and supplied with power from an external synchronous source sufficient to run the whole machine, and the portion not so used may be made to circulate the current within the armature; the different poles of the armature are, however, not equally loaded.

*Armature Windings.*—Mr. Rechniewski, in. Lond. Elec.," gives the second part of his article, the first part of which was abstracted in our issue of Feb. 18. In the present portion he considers armatures for 4-pole machines. Referring to the three types of armature,

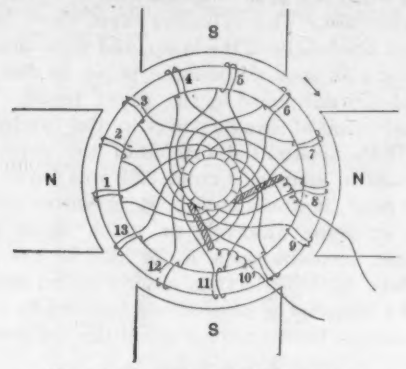



FIG. 1.—ARMATURE WINDINGS.

namely, ring, drum and disc, he says from a theoretical standpoint the windings in all three are quite similar, and that those of one can readily be deduced from those of another type. He discusses a 4-pole machine with a Gramme winding and 4 brushes connected two-and-two in parallel; in this arrangement it is evident that all 4 poles must be exactly alike magnetically, otherwise there will be parasitic currents circulating in the armature itself which tend to reverse the current in the weak field. He then shows the well known arrangement of connecting opposite commutator bars together, in which case only two brushes will be required 90° apart; it has the advantage over the former in that the parasitic currents mentioned will no longer circulate through the brush contact, and will therefore not develop sparking. Such currents are generated only when the machine is running empty; when fully loaded the armature reactions tend to equalize the fields; the energy lost by virtue of these currents is, however, small, as they themselves produce a reaction which tends to equalize the fields. In the second case the number of coils must be even and equal to the number of commutator bars. He then shows a system of winding in which the diametrically opposite coils are connected in series, and the two opposite commutator bars are metallically connected so that only two brushes are required. In 6-pole machines the coils which are separated by 60° must be connected in series, and between two commutator bars there will then be three coils in series in place of two; the number of coils must be even. He also shows a modification of this same winding in which the number of junctions is reduced to one-half. In these windings the number of commutator bars is equal to the number of bars, but between two consecutive bars there will always be two coils in series, there being four poles to the machine. He also shows a modification of the latter in which the number of commutator bars is double for the same number of coils; in this case there will only be one coil between two commutator bars. He next shows the winding given in Fig. 1, which is absolutely symmetrical, and requires but two brushes and does not require cross connections between two opposite commutator bars. This winding is used more frequently for drum and disc armatures; the number of coils is equal to the number of commutator bars; between two bars there are two coils connected in series; for a 4-pole machine the number of coils must be odd. In this winding as well as in the others, the parts connected in series are situated in the fields of the same polarity; coils in fields of opposite polarity may also be connected in this way provided their direction of winding is opposite (or if the winding is in the same direction, by reversing the connections at the ends of the coil); this is shown in Fig. 2; in this winding the number of coils must be even. In this only two coils are connected in series, but it may also be extended to include four coils, one in each field, being careful to see that their direction of winding (or their connections) is opposite in

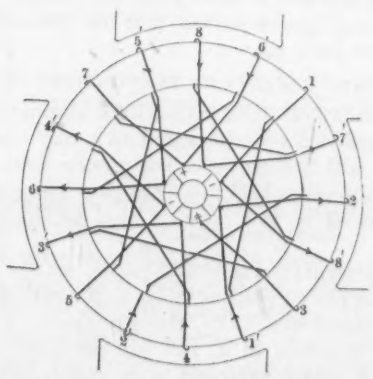
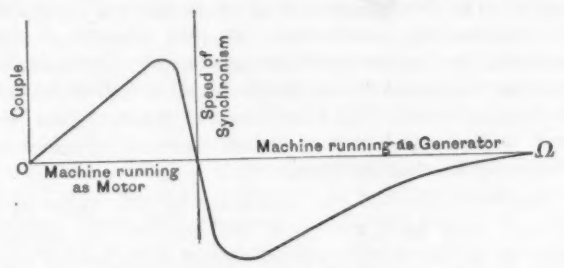


FIG 2.—ARMATURE WINDINGS.

fields of opposite polarity; the total number of coils will then be even and will be double that in Fig. 2; this is applicable also to machines with more than 4 poles; he illustrates this winding, but it is so easily deduced from Fig. 2 that a cut is not necessary to explain it; for a

4-pole machine the number of coils in this winding is four times the number of commutator bars. The same principle may be applied to all the preceding windings, including that shown in Fig. 1. Applying this principle to armatures in which the number of coils is odd, will give windings analogous to those of the Fritsche for a drum armature and of Desrozier for disc armatures, which will be considered in a subsequent article.

*Alternate Current Motors*.—Regarding the discussion about the anticipation of Mr. Brown by Messrs. Hutin & Leblanc, the Lond. "Elec." gives the following summary regarding the motor proposed by the latter as early as May, 1891: "Imagine a machine with an even number of magnet poles, the magnetizing coils being so wound that a steady current flowing through them would magnetize the poles alternately north and south. Let the armature, which is to be the movable part of the machine, be provided with two sets of coils, the coils in each set being as numerous as the pole pieces of the machine, and being wound alternately in opposite directions in the usual manner. Also, suppose the coils of the first set to be situated on the armature halfway between those of the second set, so that if the machine were used as an alternator with a double-wound armature the electromotive forces in the two armatures would differ in phase by a quarter of a period." To run the motor they pass an alternating current through the field magnets after short-circuiting the armature circuit. The power is nearly proportional to the speed of the motor, until synchronism is nearly attained, after which it falls off and becomes negative, the machine acting as a dynamo, as will be seen from the following cut. In order to obtain a more constant torque, they propose to double the number of field magnets to correspond with the two sets of armature coils. Two currents of different phases are then required, when it is claimed that the turning moment then becomes more constant. Commenting editorially on this discussion the Lond. "Elec." says that a common feature of the two motors is that no torque whatever is developed until the armature is set in motion. In each case the torque increases with the speed until synchronism is nearly attained; Brown uses only a single wound armature, while Hutin & Leblanc employ one which is double wound. "When the field magnets of a dynamo are excited with an alternating current, the




POWER CURVE OF ALTERNATING CURRENT MOTOR.

magnetic field produced may be regarded as a revolving field of nearly constant strength, the speed of revolution corresponding with the frequency of the alternating current. If the armature of this machine be rotated at some other speed, the frequency of the alternating current induced in its coils will correspond with the sum or difference of the speeds, according as the armature is rotated in the opposite, or in the same, sense as the inducing magnetic field. It is on an effect of this kind that the action of Hutin & Leblanc's motor depends. Prof. Trouton made use of the same principle when endeavoring to produce currents of high frequency for electric radiation." (See Lond. "Electrician," Jan. 22, 1892.)

*Transformer Ratio*.—Mr. Rankin Kennedy writes to the Lond. "Elec. Rev." that Mr. Dalrymple, in a paper read before the Royal Scottish Society of Arts, published in the "Practical Mechanics' Journal," in March, 1849, was the first to show that the ratio of transformers was proportional to the lengths of the wire in the two different coils. He gives a formula based on this ratio for calculating the transformed current. It may be of interest also to note that the same author suggested, at that early date, that "galvanic electricity would ere long be employed for lighting our streets in place of gas." Mr. Kennedy adds that this sugestion has not yet been adopted in Edinburgh, where this paper was read half a century ago.

*Definitions*.—Mr. Kingdon, in the Lond. "Elec.," calls attention to the fact that the term "dynamo" is used loosely. He shows that originally it referred to the use of the dynamic principle, or what is known as the self-exciting principle, in order to distinguish such machines from magneto machines in which permanent magnets were used. He offers the following definitions: 1. A dynamo machine is a self-exciting machine for transforming mechanical energy into electrical energy by the generation of continuous currents. 2. An alternator is a machine for transforming mechanical energy into alternating current electrical energy. 3. An electromotor is a machine for transforming electrical energy into mechanical energy.

Mr. Weymouth continues his long serial on sparking at commutators, in the Lond. "Elec.," March 3, accompanying the same with quite a number of illustrations.

### ARC AND INCANDESCENT LIGHTS.

*Leading-in Wires*.—Mr. Proctor writes to the Lond "Elec." that he has tried making the leading-in wires of iron well enameled and then embodied in glass approaching the enamel in composition. He succeeded in making one or two lamps which retained the vacua, but a little consideration of the commercial aspect of the question showed that at the present price of lamps, if the new lamp gave, say, 10 per cent. more loss by bad vacua and defective lamps, this loss would be more than sufficient to pay for the whole platinum in the lamp. He tried a copper-tin alloy (much like the one mentioned last week), but with only very unsatisfactory results. From the platinum point of view, he thinks the American Edison lamp as nearly perfect as possible, but states that the joint between the stem and the bulb is difficult to make. He illustrates a new joint, devised by himself, which overcomes the difficulty and is extremely easy to make, and which enables bulbs, with a relatively large difference between their coefficients of expansion and that of the interior glass stem, being used without cracking. He concludes that there is very little room for economy, unless a substitute is found in every way equal to platinum. The cut he gives is not sufficiently clear to warrant reproduction.

*Non-absorbing Globes*.—It is well known that opaque globes absorb a very large amount of the light of arc lamps, also that there is a dark shadow cast directly below an arc lamp. To avoid these, Mr. Fredureau ("L'Elec.," Feb. 25) describes a new globe made of transparent glass with circular depressions having such faces as to form lenses (similarly to the well known lighthouse lenses), the curvatures of which are so calculated that they refract and reflect, so as to diffuse the light. Such globes may be made of pressed glass, and, although more expensive, they diffuse light much more economically than absorbing opal or ground glass globes.

### CENTRAL STATIONS AND INSTALLATIONS.

In the central station at Zurich, an insulation resistance is required varying from 400,000 ohms for the wiring of five lamps to 40,000 for 50 lamps; nothing lower than 30,000 ohms is allowed. In order to avoid the introduction of lamps which are used very little, they make an annual charge of $2 per incandescent lamp, and $5 per arc lamp installed; in addition the current is charged for at the rate of 14 cents per kilowatt hour; the consumer pays for the lamps which are furnished by the station. There is an annual charge made for the meter, varying from about 75 cents per quarter of a year for 10 lamps to $2.70 for between 100 and 200 lamps.

*Private House Plants*.—The Lond. "Elec.," March 3, gives a short description, accompanied by two very good cuts, of the Scott-Sisling system. In this a special dynamo is used having two windings on its armature and two commutators. The lamp current is taken from the principal commutator through the series coils on the dynamo magnets. The charging current for the accumulators is also taken from the principal commutator, but through an extra winding on the armature instead of through the series coils on the magneto, so that its pressure is increased while there is no risk of the dynamo being reversed. The battery is connected inside of the compound winding, whether it is being charged or discharged; in the latter case the battery current traverses the series coils, thus tending to diminish the charge of the battery as long as the dynamo is able to give the required out-puts.

*Charging*.—In the station in the city of Trente (Tyrol, a curious method of charging is used. The rate is 20 cents per candle year, and to prevent waste of current the municipality (who own the plant) reserves the right to renew the lamps, making a heavy charge for them. The charge for power is $4.25 per horse power per year, the motors being switched off during the hours of maximum lighting. They use the five-wire system of distribution. This awkward system is also used in Koenigsberg, Paris and Manchester.

*Load Factor*.—Mr. Carter in the Lond. "Electrician" shows how the load factor of a central station depends on the latitude of the city, and points out the importance of taking this into consideration in designing stations for cities having different latitudes. From astronomical data he works out the load factor for various cities, and shows how very different it will be for places where the relative lengths of day and night vary very greatly. Even in the United Kingdom the load factor will be different in the north and in the south. He states that, therefore, the mathematical equation of the load factor of every station will be a trigonometric function of the latitude of the place. He also states that the latitude has an indirect influence in the effect of climate on the refraction and transparency of the air; also on the twilight and on the amount of light received from the moon. All this put together, however, was not equal in importance to London fogs.

*Accumulator Stations*.—The "Elec. Zeitschrift," March 3, gives a very complete and extended description of the central station at Hanover, installed by the firm of Schuckert & Co. It is accompanied by 19 very good illustrations, including working plans, elevations, views, diagrams and many details. It is one of the most complete descriptions of a central station which has been published. In this station the dynamos charge a double set of accumulators, from which four currents of different voltages are led to four distribution centres at various distances from the station, the voltage being higher as the distance is greater, so that each centre has the same voltage. This is accomplished by using more or less cells for the currents for the different centres; no current is therefore wasted in resistances; the end cells are cut out of the charging circuit as soon as they are full. The description is well worth the attention of those interested in accumulator stations, as this is probably one of the finest stations of that kind in existence. The cuts alone are in most cases sufficiently clear to be of use to those who cannot read the German text.

"L'Ind. Elec.," Feb. 25, describes and illustrates the central station in the city of Quinton, France, in which accumulators are used driven by water power. The description includes illustrations of a plan and elevation and large, clear views of the switchboard and its connections.

The Lond. "Elec.," March 3, gives a short description of a central station at Christiania, in which only a small battery of accumulators is used, intended only for night and mid-day service and as a reserve.

The following central stations were described: "L'Elec.," Feb. 25, continues its description of the central station at Zurich, including illustrations of the junction boxes and transformer stations in the city, as also a section of the conduit used. Lond. "Electricity," March 3, describes the central station at Havre, accompanying the same with a number of illustrations.

"L'Ind. Elec.," Feb. 25, begins a serial on the installations in Switzerland; in the present number is described the first station erected in Switzerland, in the city of Lausanne.

In France a Bureau for the Control of Electrical Installations has been formed, the object being to undertake the testing and periodical inspection of wiring, and also to collect electrical data for the benefit of such stations; it is expected to derive a sufficient income for its maintenance from the fees. The idea appears to be a very good one, and might, perhaps, be applied to advantage in this country also.

Mr. Newitt in a paper read in England, reprinted in full in the Lond. "Elec. Eng.," Feb. 24, with twelve well selected illustrations, describes in a semi-popular manner the electric fittings for lighting, signaling, telegraphing and motive power on board of ships, including also apparatus for cooking, firing guns and for search lights.

### WIRES, WIRING AND CONDUITS.

*Conduit*.—The Lond. "Electrician," Feb. 24 describes and illustrates the Doulton vitrified stoneware conduit which is made in lengths of 3 feet, and with two or more ducts; the interior surface is hard and glazed. A joint is made with a canvas band, surrounded by a cast iron trough filled with cement. Another kind of a joint is made by placing a rubber block in the duct at the joint; by axial compression, produced by means of a rod and tube leading to the outlet of the next duct, the rubber is expanded by compression so as to fill the duct at the joint; the joint is then filled with cement and is inclosed in a cast iron trough.

*Dog Labor*.—The Crompton Company, in England, uses a small fox terrier dog for running pilot lines through underground conduits. A string is tied to the dog's collar, he enters at one end and comes out at the other carrying the line with him. He is said to enjoy his work, but receives no pay. It is said to be a cheap and very effective method.

*Compound Telephone Wires*.—Experiments are being made in Germany with a wire having a core of aluminium bronze and an outer envelope of a copper bronze; such a wire is said to have a low resistance and a high tensile strength.

*Oil Insulators*.—In "L'Ind. Elec." Feb. 25 (reprinted in full in the Lond. "Elec. Rev.," March 3), Mr. Tanner quotes from a French patent to Messrs. Lenoir & Prud'homme, No. 36,216, of June 24, 1869, showing that this was the first invention of the use of liquids in insulators for aerial lines. The article is illustrated, and contains a copy of the patent. Several other like insulators are also shown.

### TELEGRAPHY, TELEPHONY AND SIGNALING.

*Steno-Telegraphy*.—The "Elek. Zeitschrift," March 3, gives in full a very lengthy description of Mr. Jaite's system of steno-telegraphy, illustrated with a large number of diagrams of the signs. In steno-telegraphy, as is well known, the sounds and not the letters are represented by characters, and it therefore differs from the usual method, as shorthand writing differs from longhand writing. It is claimed that greater economy and greater speed are attained.

*Telephone Statistics*.—From a paper published in a recent number of the "Journal Teleg.," on telephone statistics (published also in "Elek. Zeitschrift," Feb. 10), in which, however, several large countries like France and

England are omitted, it appears that out of eight hundred million calls, five hundred million are on the line of the American Bell Telephone Company. It also shows that in these countries, including almost all the large countries except France and Great Britian, there is a telephone to about every 600 inhabitants, and a telephone station to every 100,000 inhabitants. The mean number of calls per subscriber a day is about 7; that for the American company is very close to this, being 7.6.

*Induction Signaling.*—Mr. Stevenson read a paper before the Royal Society of Edinburgh on "Induction at Great Distances Through Air and Water Without the Use of Parallel Wires," as a means for electric signaling to ships at sea. He proposes that a cable might be laid down in the sea, and that by changing the electric state of the cable, vessels passing near it might, by means of a detector, discover that they were in its vicinity, thus locating their position. He constructed instruments that would act through over 30 fathoms of water. One of these was a coil of uninsulated copper wire rope or other water connection, dipping into the water; one of these was at the bow and the other at the stern; if these were joined by a wire through a telephone circuit it made a very sensitive instrument; when the ship was at right angles to the cable sounds from a magneto-electric machine were audible in the telephone. If the water connections were equidistant from the cable, no sound was heard; the coils in the water can also be insulated; the cable may be insulated or not; the action appeared to be electrostatic on the principle of a voltmeter detecting differences of potential produced by the charging and discharging of the cable. The action was injuriously affected by the increase of conductivity of the water. The second instrument was a coil of insulated wire surrounding a core and having a telephone in circuit; making and breaking the current of six dry cells in a wire one-sixteenth inch in diameter and 200 feet long could be detected 40 feet off, or, with 12 cells, 60 feet off. The presence of the water made no difference; the audible distance is in proportion to the amperes; the sound was almost deafening at 3½ fathoms; a magneto-machine was not as effective as dry cells. The second system had no earth connections and is a true induction system. A few cuts, though not of much use, will be found in the Lond. "Elec. Rev.," Feb. 10.

*Fire Alarm.*—The Lond. "Elec. Eng.," Feb. 24, describes and illustrates a new fire alarm, consisting essentially of a small metallic air box placed in the room and connected with a tube to an electrical contact maker; in case of fire the air in this box expands, acts on a rubber diaphragm in the contact device and thereby sounds an alarm and operates a relay. The difficulty in this is to determine the point where the dangerous temperature begins and the ordinary temperature ends.

The "Elek. Anzeiger" in its issue of Jan. 26 begins an extended illustrated serial, with numerous illustrations, of the fire alarm telegraph system in Paris. "La Lum. Elec.," March 4, contains a long, well illustrated article on the same subject.

*Railway Signals.*—The "Elek. Zeitschrift," Feb. 24, contains a long, well illustrated article by Mr. Wehr, of Vienna, on electrical railway signals.

*Bells.*—The Lond. "Electrician" suggests that cheap and reliable resistances of several hundred ohms might be used for electric bells, instead of Leclanche batteries, in houses furnished with electric light; the advantage is that they require no attention. It also suggests that this current would be too small to be registered in the meters and would therefore cost nothing.

*An Electric Horn.*—Mr. Woakes in the Lond. "Elec." describes a substitute for electric bells in houses supplied with alternating currents. It is based on the principle of the telephone receiver, and consists of a disc of sheet iron placed in front of one of the poles of an electro-magnet, through the coil of which passes an alternating current. In order to obtain an intense sound with a small current, the disc must strike, while vibrating, the iron core or some other body. A sufficiently loud sound was produced with one ampere; there is, of course, no make and break in such an apparatus.

### ELECTRO-CHEMISTRY.

*Chlorine and Soda.*—Mr. Andreoli has an article in the Lond. "Elec. Rev.," Feb. 24, on the electrolytic production of chlorine and soda. It is almost entirely a criticism of a recent paper by Messrs. Cross and Bevan. He describes the Le Sueur process, and gives numerous figures of cost for this and other processes. In conclusion he states that the production of chlorine and soda by the electrolysis of salt is an accomplished fact.

*Brass Plating.*—In the "Elek. Echo" the following receipts for brass baths of Mr. Pfanhauser are given. It is stated that the ordinary baths give considerable trouble, as they are irregular, unreliable and particularly unsatisfactory, for plating iron and small articles in baskets. The following bath is said to overcome these difficulties: 1 litre water; 40 grammes of the double cyanide of copper and potassium; 40 grammes double cyanide of zinc and potassium; 2 grammes of pure 100 per cent. cyanide of potassium; 2 grammes crystallized ammonia chloride; 10 grammes ammonia soda; dissolved at a lukewarm temperature, stirring until all salts are dissolved. It is ready to be used immediately, requiring no further preparation. The bath should have a temperature of about 70 to 75 degrees F.; for plating zinc 2½ volts are required; for iron, 3 volts; for small articles, 4 volts. This bath differs from the usual baths, in containing about three times as much metal in solution; it is somewhat expensive at first, but is claimed to be cheaper in the end. It is adapted for plating all different metals equally well; even cast iron is very easily plated. Should a green slime form on the anode, add some cyanide of potassium, and if after a while it becomes weaker in the amount of the metals contained add some of the double cyanides of either or both.

He also gives a bath for copper plating which is precisely the same as the above, only that the zinc is replaced by copper, making, therefore, 80 grammes of the double cyanide of copper and potassium. It should be used at the same temperature, and requires about 3 volts.

He also states that 40 grammes of the double chloride of ammonia and tin in 1 litre of water makes an excellent bath for tin plating; it requires but 1½ volts, is very easily made, and is very cheap; it should be used at the same temperature as the above. The deposit has a dead lustre and requires to be polished with a scratch brush. For plating iron, particularly cast iron, he recommends plating with tin first, then polishing and afterward plating with brass or copper; the latter finishes up much finer, as the pores are closed by the tin.

*Accumulators.*—A German firm is starting the business of supplying charged accumulators to buildings, and replacing them by others when discharged. It appears to be limited to the lighting of a few lamps only. For a battery for running two lamps of 16 c. p. six hours a day, the charge is $6.40 per month, and for four lamps, $8.50 a month. Each consumer receives two charged batteries, of which only one is used, the second answering as reserve while the first is being charged.

### MISCELLANEOUS.

*Ozone.*—In the Lond. "Elec. Rev.," Feb. 24. a correspondent gives the first part of an article on the application of ozone, in which he proposes to give an illustrated description of the ozonizers, which have been constructed during the last 40 years, and also to summarize the report made by Dr. Froehlich on the experiments made in the Siemens & Halske works during a year and a half. Many of the following statements are from the latter report: Ozone kills small animals and all insects without exception within twenty minutes. The only exception is a coleopter, found in bakeries and restaurants. Bacteria in water are also killed by ozone, but it is yet a question whether those in the air and the spores are destroyed. It is given as an undisputable fact that ozone kills impurities in water; if water is ozonized and filtered, all organisms remain in the filter. By the Siemens process 2 h. p. produce 2.4 mg. of ozone per second. The applications of ozone will increase rapidly when it becomes possible to compress it and sell in that form; compression, though, may decompose ozone. He thinks, however, it is almost absolutely certain that this problem will soon be solved satisfactorily. One of the principal applications of ozone is for bleaching, but it has injurious action on certain substances which tends to counterbalance its advantages. Wines and spirits are improved by ozonization, a process commercially used in France and America. Light wines, however, present difficulties, because a too long treatment gives rise to a formation of aldehydes and vinegar. The expense in thus aging and refining alcoholic liquids is trifling. Whether it can be applied for clarifying sugar is doubtful. One of its important applications is the purification and disinfection of air and articles contained in the air. The insecticide properties of ozone, he says, are remarkable and promise wide applications. Ozone passed through the earth immediately causes worms to emerge at the surface; it is suggested to use this method to destroy the phylloxera which attack vineyards. After experimenting with ozone, that writer found that the rats and mice in his laboratory, which before were numerous, completely disappeared. Many experiments to disinfect and sterilize water were completely successful, but it remains to be proved that the ordinary bacteria of typhoid, cholera, etc., and their spores are also killed by ozone. Bacteria which generate putridity are all killed. Impure water when ozonized is therefore rendered drinkable. Compared with sterilization by boiling the ozone process is much cheaper and quicker, and it has the advantage over chemical disinfectants that it leaves no trace in the water; it passes through the water, kills the bacteria and escapes. It is of great importance in the manufacture of ferments for breweries and for the preparation of yeast. Dr. Froehlich, in conclusion, says that there is already a very promising field of which the limits cannot be perceived. In the Siemens process the interrupted current gives better results than the usual alternating current.

The issue of March 3 contains the second part of this article. Dr. C. Fox advocates the use of ozone in hospitals, saying it could be diffused through fever wards, sick rooms, crowded localities or wherever the active power of the air is reduced and poisons generated. It may easily be disseminated through public buildings, theatres and through confined atmospheres. When diluted the odor of ozone is refreshing, bracing, pungent and exhilarating, but when concentrated it becomes unbearable. Water is ozonized in the following manner: Oxygen in the iron cylinders under pressure is first washed and dried, then passed through Siemens' tube, where it is ozonized up to 15%; this ozonized oxygen is led through tin pipes into earthenware cylinders 6 feet high and 3 feet in diameter full of distilled or sterilized water containing 4 to 5% of certain phosphate salts. In these reservoirs there are 26 terra-cotta sieves with very small holes through which the ozone is forced from the bottom, at about 5 atmospheres pressure, passing through the water in small bubbles; it is rendered stable by a patented process; the cylinders are kept cooled to at least 10° C. by means of ice.

He then quotes from a long paper by Mr. Schneller, but warns the reader against the accuracy of the figures. According to these figures each kilogram of ozone would require 3.48 h. p. hours, or, allowing for a loss, 4 h. p. hours. When atmospheric air is ozonized, instead of pure oxygen, nitrous compounds are formed which render the application impossible for certain purposes; it destroys the fibre of some fabrics, and in purifying sugar it makes it acid; it is almost impossible to separate nitrogen from ozone. He then describes the various ozonizing apparatus, beginning with the first one suggested 40 years ago. Among these are the Siemens apparatus of 1857, the Von Babo of 1863, and the Beane of 1868, all three of which are illustrated. The article is to be continued.

*Submarine Navigation.*—"L'Elec.," Feb. 18, describes and illustrates an apparatus devised by M. Goubet for effecting a vertical motion of a submarine boat. One of the usual methods is by means of a horizontal rudder, another by an additional propeller; both of these, however, have objections. In the present device one or more large cylinders are placed in the boat, and have a piston operated by a screw turned by an electric motor; one end of the piston communicates with the water; by moving the piston, more or less water is taken into the cylinder, which varies the displacement of the boat, and therefore raises or lowers it. The amount of energy required to move the piston is less than that for a propeller to produce the same effect. Besides describing these methods, the article also mentions electric regulating apparatus, by means of which the direction and depth may be kept constant. The latter may be accomplished by a sort of horizontal rudder, which starts or reverses the motor for moving the piston.

*Gutta-percha.*—If the statement of Mr. Serullas, of France, may be relied upon, the gutta-percha industry may be almost revolutionized. From experiments made by Mr. Yungfleisch, in Java, he finds that the raw material may be obtained from the leaves of the iseondra tree, instead of from the trunk, as at present. By the old method a tree, at the cost of its life, gives four ounces of the material, while by the new method, every six months 200 pounds of the dried leaves may be taken from the tree without injury, which yield 8 to 9 per cent. of the raw material; this material, tested in a laboratory in Paris, was reported to be true gutta-percha. The yearly supply from a full grown tree is from 32 to 36 ounces, instead of one-half ounce, as from the old method. Even of withered leaves from a tree whose trunk will yield no more juice one-half as much material can be obtained as from large trees. Trees four to five years old yield 9 ounces from one harvest of leaves. He states that old trees which are of no use to the natives at present can yet be made, by this means, to yield a large amount.

*India Rubber.*—"La Lum. Elec.," March 4, continues its serial on caoutchouc.

*Lightning Rods.*—The Lond. "Elec. Rev.," Feb. 10, p. 146, in an interesting article, appears to show that the lightning rod was invented by a Catholic priest named Procopius Diwisch, in a small Bohemian village, in 1754, June 15, and that he, therefore, anticipated Franklin. He noticed that lightning was an electric spark and worked out a complete theory of atmospheric electricity. He also noticed the effect of points. He constructed a rod having 324 needle points; the bottom of the rod was connected to earth.

It is claimed that meteoric iron sometimes contains diamonds. Mr. Bidault proposes to extract these by heating the iron to the temperature of fusion and passing an electric current through it. Further details are not given.

The artificial preparation of diamonds, mentioned in our last issue, is described at some length in "L'Ind. Elec.," Feb. 25.

The Lond. "Electrician," Feb. 24, gives a curve showing the price of platinum from the year 1870 to date.

*Electricity in Medicine.*—"L'Electricite Pour Tous" continues its serial on the medical and physiological effects of electricity.

Dr. Szuman, in the "Zeitschrift f. Elek.," illustrates and describes a universal commutator for making all the necessary complicated connections of batteries and electrical apparatus used for medical purposes.

### The Malden Electric Company's Plant.

The Malden Electric Company's plant, situated on Centre street, Medford, Mass., has taken its position as one of the best electric light plants in New England. This company is the successor of the Malden Electric Light Company, which was started and owned by Mr. A. C. Pond and Mr. E. Batchelder, who in company with Dr. Mason were the originators of the well known Simplex wire. The old company operated its plant in a frame building located in the rear of the present works and introduced electric lighting into Malden in 1886, running about 23 lamps on its circuit. The company flourished under the supervision of Mr. A. E. Bliss, who is the present general manager, till 1888, when a syndicate bought out Messrs. Pond and Batchelder, and organized the Malden Electric Company, with a capital of $100,000, later increased to $150,000, and bonded at $100,000. The officers of the company are as follows: John S. Bartlett, of Lynn, president; H. A. Royce, of Boston, treasurer; Chas. H. Richardson, of Boston, assistant treasurer; C. W. Royce, of Lynn, secretary, and A. E. Bliss, general manager. The board of directors are H. A. Royce, J. Bartlett, and Joseph N. Smith.

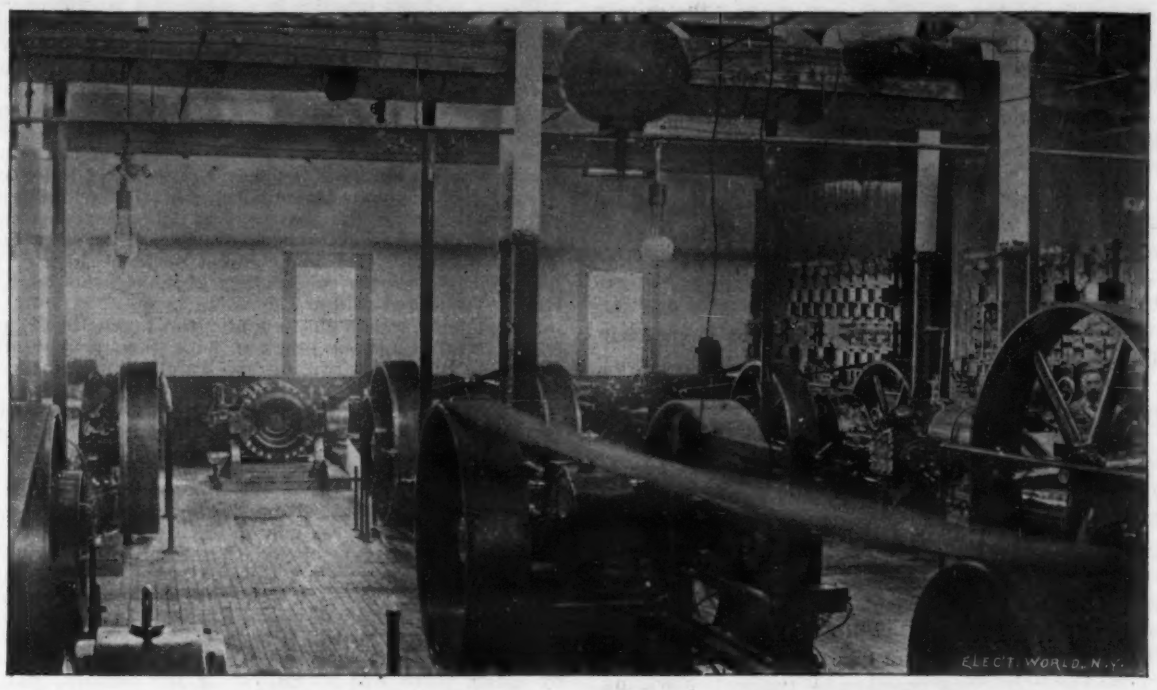



FIG. 1.—THE MALDEN ELECTRIC COMPANY'S ORIGINAL STATION.

On June 1, 1888, the present building, whose dimensions are 67 × 60 feet, was completed. It is substantially constructed, thoroughly fireproof, and well suited for the purpose for which it is designed. The installation consisted of one 580-h. p. Armington & Sims engine, one 150-h. p. McIntosh & Seymour engine, and four Whitney engines of 150 h. p. each. The steady increase of business made it necessary to enlarge the plant, and the addition was opened on Feb. 15, last, in the presence of the municipal councils of Malden, Everett and Medford, and prominent citizens from these and other neighboring towns.

The addition is slightly larger than the original station, covering an area of 70 × 60 feet. It is thoroughly fireproof and equipped with the best modern machinery. The lighting capacity of the combined station is 250 arc lamps, 1,600 25-c. p. incandescent lamps for street lighting and 9,000 incandescent lamps for commercial use, and 3,000 for residence lighting. The company supplies the entire electric lighting of the cities of Malden, Everett and Medford, and the town of Melrose, covering a district of about 30 square miles and requiring the constant use of about 600 miles of wire. Almost all of the wire used is of the Simplex brand.

The boiler rooms are in the rear of the buildings and connected with both stations. They contain four large Whitney boilers and two of equal size supplied by the Roberts Iron Works.

In Fig. 1 is seen an interior view of the old station, while Fig. 2 represents the new station as now in operation. The plant is thoroughly equipped, and has been operated with marked success.

### Unjust Law.

BY A. B. UPHAM.

In The Electrical World of Feb. 25 is an article upon "The Telephone Situation." It is interesting, but contains a statement likely to mislead the uninformed reader. This is the assertion objected to: "The life of a patent in the United States is limited by the life of the foreign patent that expires soonest."

This is true only upon certain conditions. When the foreign patents have been filed before the issuance of the U. S. patent, the life of the latter is limited as above quoted.

If, however, the foreign applications are not filed until after the U. S. patent issues, there is not the slightest limitation of its life. Furthermore, previously filed foreign patents may expire, and the U. S. patent upon the same invention remain in force.

By recent decisions, the life of a foreign patent is taken as the longest term of years for which such patent may be granted. For instance, England issues a patent for fourteen years, but subject to certain taxes, the non-payment of which terminates the patent. By such forfeiture, the English patent may expire in three or four years; but the subsequent U. S. patent is valid for the full fourteen years.

In Canada, a patent may be secured for five, ten or fifteen years. The patent may be taken out for five years only, and not extended at the expiration of that time. The U. S. patent affected thereby will, however, be held in force for the fifteen years to which the Canadian patent might have been extended.

These exceptions only emphasize the fact of the injustice and foolishness of the law limiting the U. S. patent by the prior foreign ones. In his last annual message to Congress Commissioner Simonds strongly urged its repeal. It would be well if voters everywhere would strongly express to their representatives in Congress their dissatisfaction with the present legislative neglect of the patent office and patent laws.

But to return to our subject. Some puzzled inventors may inquire: "If the U. S. patent is limited to expire with the shortest previous foreign patent, and the foreign patents (or most of them) are invalid if filed after the U. S. patent is issued, what is the poor inventor to do?" But let him not worry. The experienced patent attorney can easily arrange the apparently paradoxical problem for him all right. The foreign patents will be filed upon the same day, or the day or two after, the U. S. patent is issued. The only essential is that the time elapsing before the filing of the foreign patent shall not equal the time required for the mails from the U. S. to reach such country. For the law in many countries invalidates a patent filed subsequent to the publication or reception in the respective country of any printed description of the invention. This brings up another question, upon which I have never seen a decision. Suppose an inventor publishes in some newspaper in the United States a full description of his invention, and in a few weeks thereafter files an application for patent upon the same in some foreign country—France, for instance—he then secures a patent in this country, limited to fifteen years of the French laws. If, now, upon pushing his patent in France, he finds it to have been invalidated by the printed publication above referred to, what is the length of life of his American patent?

Theoretically, and so engrossed upon his patent papers, its life is but fifteen years. Practically, however, he never had a foreign patent, it having been void from the beginning. This is only one of the many absurdities into which the courts are led by the unjust law of limiting the U. S. patent by the prior foreign one.

Here is another; one that came in my own experience. An inventor filed a U. S. application and soon after died. The administrator of his estate filed applications for foreign patents upon the invention. The U. S. patent was issued upon the same day with the filing of the foreign applications, and, hence, neither patent was affected by the other. Unfortunately, however, the letters of administration to the U. S. Patent Office were delayed, and, through an oversight of the office, the patent was issued in the name of the dead man. By a recent decision, such issue to a dead man would not affect in the slightest the validity of the patent. At that time, however, the patent was considered void, and the commissioner was required to issue again the patent in the name of the administrator. Now, this brought the date of the valid U. S. patent several weeks subsequent to the foreign one. Hence, in law, it should expire with such foreign patent. But the office had acknowledged itself as to blame for the mal-issuance. When, then, will that patent expire?

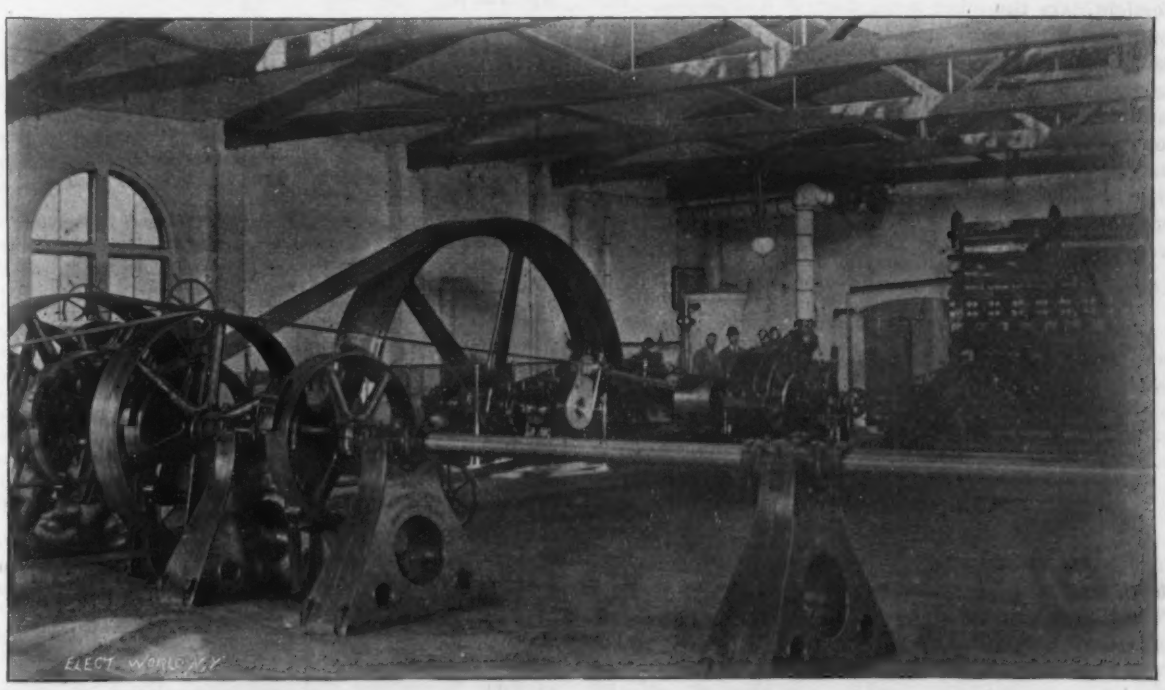



FIG. 2.—ADDITION TO MALDEN ELECTRIC COMPANY'S STATION.

## NEW BOOKS.

ALTERNATING CURRENTS: AN ANALYTICAL AND GRAPHICAL TREATMENT FOR STUDENTS AND ENGINEERS. By Dr. Frederick Bedell and Dr. Albert C. Crehore. New York: The W. J. Johnston Company, Limited. 1893. 325 pp., 112 illustrations. Price, $2.50.

The great and growing importance of alternating currents renders it very desirable that the electrician and engineer should understand the principles upon which this branch of electrical science is based; but heretofore the treatment of the subject has either been fragmentary or special in character or couched in a language requiring a special mathematical education to interpret.

With a view to placing the subject on an equal footing in this respect with other branches of electrical science, Drs. Bedell and Crehore have prepared the present volume, in which the treatment is logical and connected throughout, and the principles are gradually developed from the elementary experiments upon which they are based, enabling the student to follow every step of the process.

While the demonstrations are exact and rigorous, the final results are expressed so to be perfectly intelligible to those who do not desire to follow the proof, but are only interested in the conclusions. The different mathematical processes are given in full, so that they can be easily followed by the mathematical reader without requiring reference to mathematical works, which is so often necessary with similar treatises. In fact, the treatment throughout is complete in itself, needing no outside references to any source.

The same symbols are used throughout with the same signification, thus making the book clear and readable, and the notation adapted is given in an appendix and the meaning of any symbol is thus quickly found. All of the equations are numbered consecutively throughout, and the book is well cross-referenced that the reader may easily refer to the rigorous proof of any statement.

The first part of the book is devoted to the analytical development of the subject. Of the first five chapters

two deal with the fundamental principles and experiments upon which the theory of alternating currents is based, a third with the explanation and discussion of harmonic functions and the remaining two with circuits containing resistance and self-induction, and resistance and capacity, respectively.

The treatment of this elementary portion is so clear and the mathematics so simple that little difficulty will be encountered by any one in thoroughly understanding it, and as the greater part of the principles of alternating currents that are practically applied is here included, this section is one of the greatest practical value. The sixth chapter contains the general solution for circuits containing resistance, self-induction and capacity, and the next five are devoted to special cases under this head, including a full consideration of oscillatory charges and discharges. From a study of these chapters a clear idea is derived of the important functions of a condenser in connection with alternating apparatus, and the different effects due to a departure from the harmonic form of the E. M. F. curve. The two final chapters are on circuits containing distributed capacity and self-induction, which play a capital role in the working of the telephone, the long distance transmission of alternating currents and in submarine telegraphy.

In Part II. is given the graphical treatment of the various cases considered analytically in the first section, with extensions to include combination circuits, which are so much more easily treated geometrically. This section can be followed with little or no knowledge of mathematics and consequently will be appreciated by the many who otherwise would be unable to enter into the theory of this important subject. The same admirable system of development from first principles is here followed, and the involved cases are introduced so gradually that they are mastered before their complexity becomes apparent.

A feature of the work is the numerical examples illustrating various points, a method of impressing the consequences of principles that is of the highest value. The various curves are constructed from actual data, which is enumerated in the legend below.

The authors are to be congratulated, not only upon the matter of the book, but also on the lucidity and logical sequence of its exposition, and, we may also say, the general literary merit displayed, qualities usually confined to French scientific works.

The book is well indexed, and the mechanical execution is excellent; the typography being very handsome, the paper of an extra quality, and the binding tasteful and substantial.

THE VOLTAIC CELL: ITS CONSTRUCTION AND ITS CAPACITY. By Park Benjamin, LL. B., Ph. D. New York. John Wiley & Sons. 1893. 562 pages, 200 illustrations. Price, $5.00.

The author's strong point is compilation, and he has made a somewhat extensive search of the literature on the subject for material. In some instances the book is brought well up to date, containing matter only lately published in the original. There is a notice of the Bernados accumulator, which is not noticed in Niblett's book, probably through some oversight. On the other hand there is a mention of one Delany cell, although Delany invented more than one. Also, one Hussey cell is mentioned, a type abandoned by the inventor, his later types not being noticed. It is manifestly impossible to describe every cell ever made, but it would be possible to use greater care in the selection of those which are to be described.

The book has more typographical errors than should be permitted. Some which appeared on first inspection were p. 259, second line from top, read "sodium" for "silver." On p. 492 is the equation $\frac{1.85 \text{ volts}}{1.95 \text{ volts}} =$ 0.95 volt. The word "volt" in the second member is manifestly wrong, and should be erased. The same mistake occurs twice on p. 493. On p. 32, second line below second equation, read "copper" for "zinc." The book is not printed on as good paper as are the specimen sheets mailed to possible purchasers, but in justice to the author and publishers we will state that this is a reprehensible practice which is somewhat in fashion at the present time.

The author has inserted large chunks from different sources (which he duly credits to their respective authors) without trimming them down to fit into one homogeneous whole, and even without filling in the chinks between the contradictory statements with the mortar of editorial comments. For instance, on page 27, quoting D. Tommasi's theory, "Thus for example, for a zinc-cadmium couple the E. M. F. will always be" * * * "0.36 volt, whether the salts employed be sulphates, chlorides, acetates, etc." On p. 192, table of Regnauld's experiments, zinc-cadmium couple, we find with sulphates .30, with chlorides .23, with bromides .23, with iodides .25, with nitrates .23 volt.

On p. 17 the gram is defined as the unit of weight, instead of the unit of mass as it should be, and lower down on the page the gram is said to weigh 981 dynes without specifying locality.

We would suggest that "multiple" is just as descriptive as "multiple arc" and less confusing, as arc has meanings enough by itself. Also, in giving the synonyms, the word shunt, one of the most useful, is left out. On pp. 492-3, to which we have already referred, the author gives under the name of E. Reynier (1884), the coefficient of reduction for Plante type of cells, .95, for copper accumulator .87, and for zinc-lead peroxide, .983. It conveys a very wrong impression to stop short the quotation at this point, as Reynier immediately states that the normal values of these coefficients (which are their values in ordinary practice) are .818, .750 and .885, respectively. These values agree better with the experiments of Duncan and Liebig, which immediately follow, and also with the experience of others.

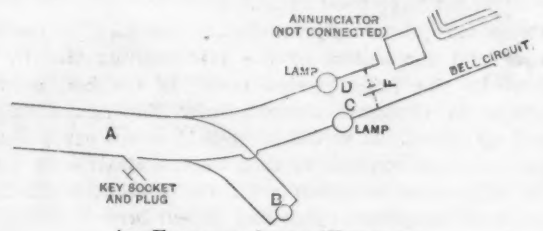
The results of Sir. W. Thomson's (Lord Kelvin) and D. Tommasi's calculations accounting for part of the E. M. F. of accumulators are given on p. 435, but the later researches accounting for the rest of the voltage on charge are not given. In defining the terms, positive and negative, the author adheres to the old nomenclature, namely zinc positive and carbon negative. This is a pity, for, however much wisdom there may have appeared to be in this nomenclature when it was adopted, it appears according to the present views of electric phenomena to be as unreasonable as to call the suction end of a pump the upper end and the delivery end the lower end. If we call positive that which is positively electrified or at a positive potential with regard to other objects, we have a rational rule which applies alike to dynamos, motors, batteries, and electrostatic apparatus.

Viewed as a whole, the work is a very creditable production, which fills a long felt want, and can be unhesitatingly recommended to those interested in the subjects of which it treats.

## An Electric Light Problem.

Some days ago in a downtown office having an electric light service, it was decided to dispense with the battery of the electric bell circuit and take the necessary current from the lamp circuit, a practice, by the way, not to be commended. Two lamps were to be used in series, as shown in the cut, and the terminals were tapped to the cord of a hanging lamp, B.

When the writer was called in the annunciator was disconnected as shown, and the lamps were conducting




AN ELECTRIC LIGHT PROBLEM.

themselves in a very unprofessional manner. When the key socket, A, was turned on, the lamp B lighted to full candle power, and the lamps C and D showed no light; when, however, the key socket was turned off, both B and C, very strangely, lighted to about half candle power.

We shall be pleased to hear from our readers on this problem before we publish the solution in our issue of April 8.

## Institution of Electrical Engineers.—IV

INAUGURAL ADDRESS OF WILLIAM HENRY PREECE F.R.S. PRESIDENT, DELIVERED JAN 26, 1893.

It is by following out this line of thought that I have recently succeeded in sending messages by Morse signals across the Bristol Channel between Lavernock and Flat Holm, a distance of 3.1 miles. The electromagnetic disturbances were excited by primary alternating currents in a copper wire 1,237 yards long, erected on poles along the top of the cliff on the mainland. The radiant electromagnetic energy was transformed into currents again in a secondary circuit, 610 yards long, laid along the island. The strength of these secondary induced currents complied almost exactly with calculations. The results attained, the apparatus used, the precautions taken to separate effects of induction from effects of conduction; the elimination of mere earth currents from electromagnetic disturbances in air, will form the subject of a separate paper, for their proper consideration would be too tedious for an address. I allude to them now only to illustrate the existence of one of the greatest proofs of the truth of a theory, viz., the practical development and verification of a conclusion predicted from mere theoretical considerations.

The oscillatory character of the discharge of a Leyden jar, which was discovered by Henry in 1842, is an admirable proof of this molecular theory. If two jars, precisely similar as regards capacity and circuit inertia, be placed near each other with their planes parallel, and one of them is charged and discharged, the other responds sympathetically, as do two similarly pitched tuning-forks when one is excited. Prof. Oliver Lodge, who has made this field his own, has shown that by varying the capacity of the jars and the inertia of the circuit oscillations can be produced to give any required rate of oscillation from 1 to 300 millions per second.

In a room or theatre, when these discharges are excited, it is a common thing to see sympathetic sparks upon the spangled walls, and among the metallic objects scattered about. The whole place is an electric field, which is violently disturbed at every spark, and everything which is "syntonized," as Oliver Lodge calls it, to the main discharge, responds in this way.

It is impossible to account for these effects, which are all cases of transformed kinetic energy, except on the mechanical theory which I have advanced. We have a source of disturbance, we have energy transmitted in waves, we have waves transformed into disturbance again. Energy passes through its various stages by the motion of matter and the action of ether. Everything is accounted for and nothing is lost. Waste energy only means energy in the wrong place.

The advance of our knowledge in this branch of electrical development has been very much retarded by the phantasies of visionary mathematicians who monopolize the columns of our technical literature and fill the mind of the student with false conclusions. I have no sympathy with the pure mathematician who scorns the practical man, scoffs at his experience, directs the universe from his couch, and invents laws to suit his fads. The American, in his quaint, humorous way, said: "Theory without practice is absolutely a worthless commodity; practice without theory is worth about $15 a week; but when both are well combined in one man of sound judgment, the combination is worth up to $10,000 a year."

My sympathies are with the earnest worker who asks Nature direct questions by sheer experimental prodding, who elicits from her stronghold the secrets of her prison-house, who presents gratuitously to the world the efforts of his labors in plain language, and who is willing modestly to follow in the footsteps of his great masters—Faraday, Maxwell, Kelvin, Von Helmholtz and Rayleigh. Such men are to be found on both sides of the Atlantic. Our own proceedings chronicle the work of Hertz, Tesla and Elihu Thomson.

I must not exclude the teacher, the much-abused professor, who combines practice with theory, and who, in our technical institutions, is training up a body of youths destined to carry on the great work in the future. Among these able men there is no one who has earned a more richly deserved reputation than my predecessor in this chair (Prof. Ayrton).

XII.—CONCLUSION.

Although my practical experience extends over 40 years, my personal reminiscences commence with the reign of the Queen, and are, therefore, coincident with the Victorian era. When we look around us and think of what we have now, it is well to think sometimes of what we had not in days gone by. I was bred in a Welsh seaport town which had no gas, there was not a steam engine in the place, the mails came from London by coach, there was no railway in the country, photography was unknown, there was no daily paper, but an indifferent weekly journal was slightly supported. A letter to London cost 1s. The flint and steel and tinder-box were still in use, and the lucifer came one day as a wonder and a surprise. Artificial illumination was obtained among the lower classes from the rushlight and the tallow dip. The molded candle came as a luxury to the upper classes. Snuffers were in use, and an oil lamp was a curiosity. Think of the luxuries we have now; of what science, and especially electricity, is daily doing for us. Progress is advancing with such rapid strides that, when the time comes for my son to chronicle to some institution of ethereal engineers his experience of 50 years' observation, the people of his day may look back with pity and amusement at the backwardness of the times of 1893. Even this address may be quoted as an illustration of the ignorance of the great Victorian period.

Cannot the electrical engineer claim some share in the progress of the world? Has he not robbed the thunder of its terror? Has he not annihilated space, bridged the ocean, and brought the Antipodes within the same fold as home? Has he not sent lightnings from Heaven, so that they go and say unto us, "Here we are?" And are not all nations of the earth more amenable to reason and less subject to passion when they are brought within speaking distance of each other? Is it nothing to have brought health and comfort and cheerfulness into the house and security into the street? Is it not something to have rendered a first-class railway carriage, flying at the rate of 70 miles an hour, as safe as one's bed? He has probed the deep, unfathomed caves of ocean. He has extracted the precious metals from their stony bed. He warns us of approaching storms, and brings to our very hearths the tamed energy of the roaring torrent. Commerce, civilization, politics, and life have all been benefited by his skill and invention, and history cannot fail to record the names of those, among whom are many members of this Institution, who, in this great Victorian era, have done so much to discharge one of the highest duties of man, the fulfillment of the functions of the true engineer.

* For the previous sections of this paper see THE ELECTRICAL WORLD of Feb. 18, p. 125; Feb. 25, p. 141, and March 11, p. 192.

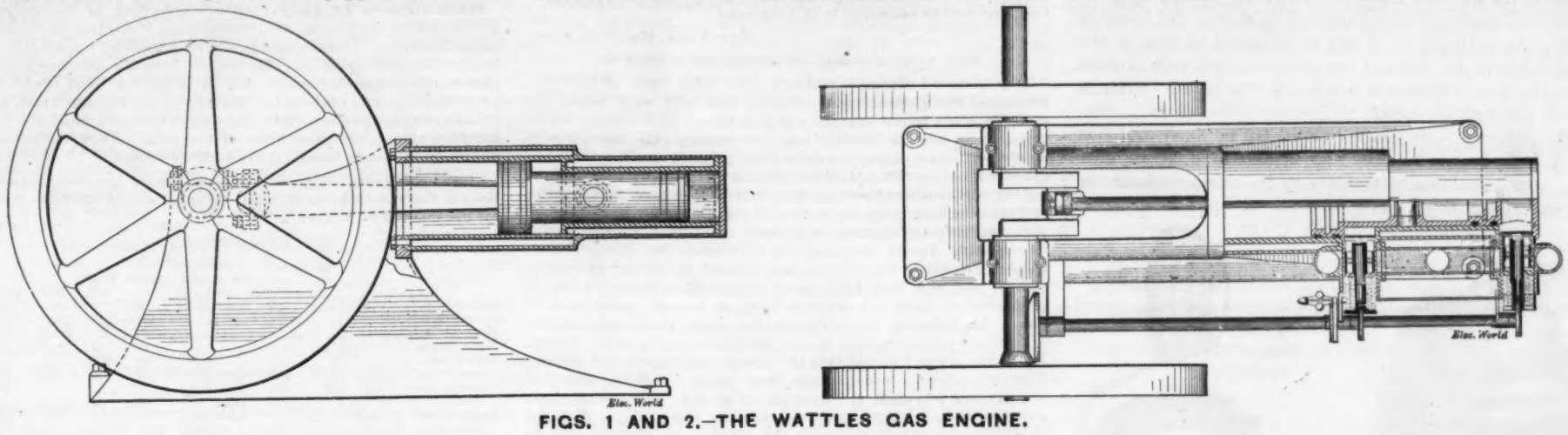
## The Wattles Gas Engine.

This gas engine, for which patents have been applied for and allowed, is the invention of Mr. Cyra B. Wattles. In design and construction it possesses many novel features not found in other engines, and practical tests have shown it to be economical, noiseless and highly efficient.

The aim of the inventor has been to produce an engine characterized by simplicity in construction, durability of parts, accessibility to valves and economy in operation. An examination of the accompanying cuts, Figs. 1 and 2, will show the novelty of design and construction. It is a one-cycle engine of the compression type, capable of receiving an impulse at every revolution. The simple combination of cylinder and piston which gives the result most to be desired in all gas engines, namely, an impulse every revolution and a corresponding increase of horse power per weight of material, appears in no other type and is the chief feature of this engine. Where an impulse every revolution has been accomplished heretofore, serious objections have arisen from the heating of the cylinder and piston to a dangerously high degree, rendering lubrication impossible. In the Wattles engine overheating has been ingeniously avoided. By reference to the cut it will be seen that the heat produced by the explosions occurs alternately in each cylinder and is thereby distributed over a larger mass of metal than in other types of engines where the

impulses concentrate on the same exposed parts of cylinder and piston

Among other novel features that are introduced in the construction of the Wattles engine there is but one valve opening into the cylinder, and this feature reduces the chances of leakage to a minimum. All valves where exposed to the heat of explosions are poppet valves and



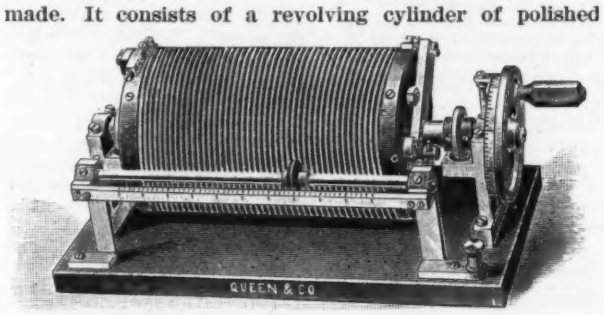
FIGS. 1 AND 2.—THE WATTLES GAS ENGINE.

therefore require no attention or oiling. The valves are also inclosed in valve bonnets, and can be removed with little difficulty. All joints in the engine are ground, doing away with the necessity of repacking, and the parts of the engine are made interchangeable. Ignition is accomplished by a closed tube heated by a Bunsen burner.

The Wattles Gas Engine Company, of Elizabeth, N. J., has made arrangements for its manufacture.

## New Queen Measuring Apparatus.

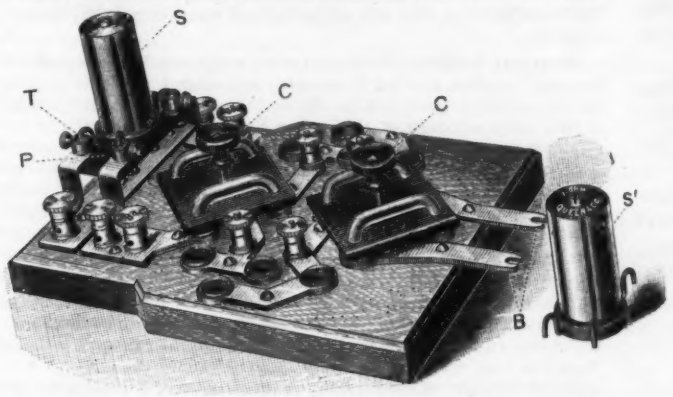
The accompanying illustration, Fig. 1, represents a new form of cylinder bridge, recently brought out by Queen & Co., Philadelphia, Pa., in which the objectionable features of old types have been discarded, while marked improvements have been made. It consists of a revolving cylinder of polished




hard rubber, 4 inches in diameter and 7 inches long, mounted on a frame. On this cylinder is cut a screw thread in which the wire is wound in 50 turns. In front of the cylinder and running its entire length is a wheel, having its platinized surface turned true so as to bear against the wire in a firm tangential contact. As the cylinder is revolved, the wheel slides along the scale always in contact with the wire. This scale is divided into 50 parts indicating complete turns. A wheel at the end of the cylinder is divided into 100 parts, each part being easily divided by the eye into tenths. Thus it is possible to read down to 1-5,000th part of the wire, or to the same fraction of an ohm. By means of two shunts placed inside of the cylinder readings as low as .000002 ohm can be made.

arranged so that two coils in multiple can be placed on either side, a very useful feature in determining the resistance of a unit length of bridge wire. By suitably turning two platforms the positions of the unknown and standard coils can be changed, as can also the direction of the battery E. M. F., making it act alternately with and against that of the thermal junction of the bridge wire and its copper terminals, and thus prevents errors arising therefrom

Fig. 3 is a remarkably efficient adjustable rheostat for laboratory purposes, depending for action upon the fact that the resistance of carbon is decreased by compression. The carbon used is in the form of rods placed flat, layer upon layer, in sections arranged for the purpose. A metal faced pressure block moving like a piston in each section, and operated by a wheel above, makes contact with the upper layer, while a metal sheet binds against the lower. Each section is constructed to carry from 0 to 25 amperes at an E. M. F. not over 5 volts. The terminals of each section are brought to a switchboard by means of which the sections can be connected




as desired. Using the sections in multiple the rheostat may be made to carry 150 amperes. Current up to 25% above these figures may be passed through for a short while

## The Pryibil Friction Clutch Pulley and Loose Pulley Stand.

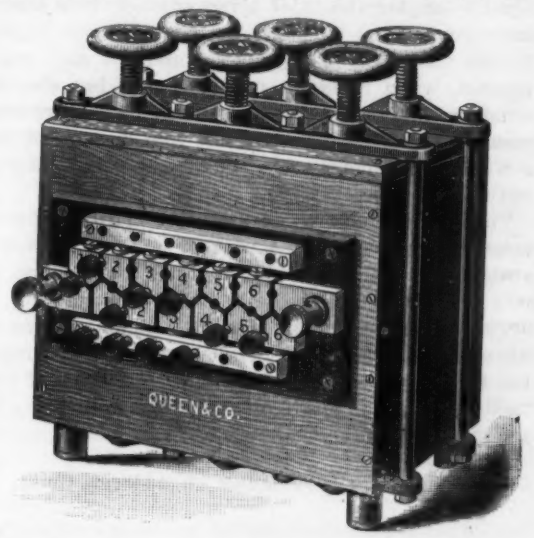
The accompanying illustrations show two devices recently placed upon the market by P. Pryibil, 542-554 West 41st street, New York City.

When friction pulleys run loose on a shaft they consume power, wear loose in the hub, and require great care to keep preperly oiled. The arrangement shown in the cut, Fig. 1, has been designed to overcome these difficulties. It consists of a quill encircling the shaft and carrying the pulley and the friction clutch. This quill does not touch the shaft, but is carried by independent, self-oiling, adjustable bearings. This device is especially intended for dynamos, and for other machinery which has to remain at rest part of the time while the shaft revolves. When used for such, they entirely relieve all

running bearings from the belt strain when the machine is at rest.

In Fig. 2 is seen a loose pulley stand as arranged for driving dynamos. It is also applicable to saw mills or to other machinery which stands at rest part of the time while the shaft remains in motion. When either a plain friction pulley or an ordinary loose pulley is used for this purpose, the hub wears loose on the shaft, power is consumed and constant care is required to keep properly oiled and prevent heating and cutting.

With the arrangement shown, the loose pulley remains at rest on a fixed bracket, except while the belt is being shifted either on or off. The loose pulley, therefore, requires hardly any attention, and the shaft is entirely relieved from belt strain, when it ceases to drive the machine. To get the belt in motion so as to shift it off

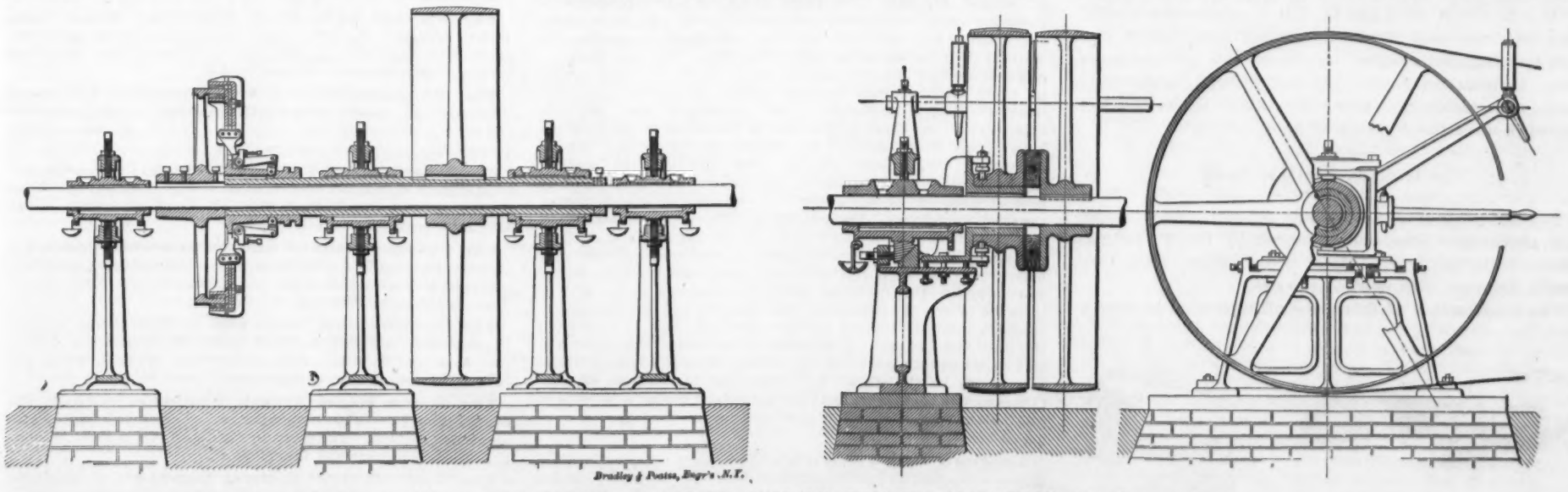



FIGS. 1, 2 AND 3.—NEW QUEEN MEASURING APPARATUS.

of the loose pulley, the latter is forced over, by a hand lever, into contact with a friction disc attached to the fast pulley on the shaft. As soon as the belt is on the fast pulley the loose pulley is again allowed to come to rest.

## A Portable Electric Combination Bell.

This invention, Fig. 1, combines a table call bell, invalid's bell set, burglar alarm, and fire alarm, and for usefulness and compactness is especially commendable. The distinct advantages of the portable combination bell will at once be seen when it is stated that the whole apparatus, including battery, and all other parts, as shown in illustration, occupies no greater space than 4½




FIGS. 1 AND 2.—THE PRYIBIL FRICTION CLUTCH PULLEY AND LOOSE PULLEY STAND.

Fig. 2 represents a special form of commutator for use in comparing resistances and finding temperature coefficients by the Carey-Foster method. The instrument consists of an arrangement of thick copper connectors, placed on an insulating base and arranged in perfect symmetry with respect to its longer axis. The terminals for the unknown and standard resistances are

inches, and, as the battery contains no fluid, the bell can be safely packed in a portmanteau or traveling bag. As a table call bell, it may combine a bell with menu and wine list holder. As an invalid's bell set, the bell may be carried to any part of the house, while the contact press is left within easy reach of the patient for whose use it is intended.

On fixing the contact press to a door or window, box or portmanteau lids, drawers, cabinets, etc., these on being opened will immediately start the alarm, which will continue to ring until the press is reset. For example, by placing the contact press under a valuable piece of plate or jewel case and carrying the bell to the bedside, instant and continuous warning would be given of any attempt to remove the article during the hours of night. As a fire alarm, it can be adjusted to ring at any degree above the normal temperature, and will at once give the alarm should a fire break out in any room in which the bell is placed.

The patent double contact press can be fixed in a few seconds to any bell push, Fig. 2, and used as an ordinary press, enabling attendants to be called without the patient rising from chair or bed; or applied to door, window, window blind, box lid, cabinet, etc., for the detection of thieves and burglars.

FIGS. 1 AND 2.—A PORTABLE ELECTRIC COMBINATION BELL.

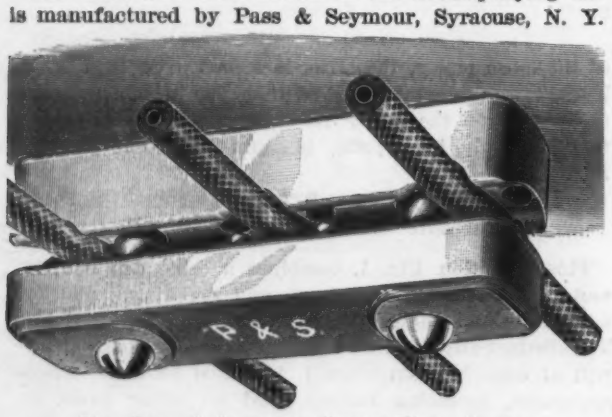
As a burglar and thief alarm contact, it is one of the most simple and efficient that has yet been introduced. Unlike all others it is portable; and not only can it be applied, when required, to doors, etc., but also to any window blind or shutter, thus offering an insurmountable obstacle to the modern burglar, who, instead of opening a window, frequently cuts out the glass and enters without noise.

The battery requires no attention and lasts for a long time without renewal. A number of these batteries in a restaurant, subject to constant use, were found at the end of nine months to be in excellent condition.

The invention emanates from London, where it has already had a large sale. It is patented in Europe and the United States, and Mr. Thomas W. Idle, of London, 74 Fifth avenue, New York City, is handling the patent for this country.

### The Pass & Seymour Three-Wire Cleat.

The three-wire cleat shown in the accompanying cut is manufactured by Pass & Seymour, Syracuse, N. Y.




THE PASS & SEYMOUR THREE-WIRE CLEAT.

It is a modification of the P. & S. two-wire cleat, which has achieved such popularity among construction men and linemen, and adapted for use on the three-wire system. It holds the wires firmly, but without danger of injury to the insulation. It is substantially made, and well suited to meet the demands of practical work.

### The Paradox Flexible Shade.

The accompanying illustrations show a style of shade and adjusting device manufactured by the F. Holman Electric Company, 128 Pearl street, New York City, which has met with marked success.

The construction of this piece of apparatus is seen at a glance by reference to Fig. 1. A simple device, shown more in detail in Fig. 2, is attached to the aluminium half shade surrounding the incandescent lamp. The cord passes through an adjustable slide, and by merely slipping this back and forth the lamp can be made to hang so as to throw its light in almost any direction. It is the embodiment of simplicity, and answers every purpose of elaborate and expensive flexible shades.

FIGS. 1 AND 2.—THE PARADOX FLEXIBLE SHADE.

# Financial Intelligence.

## THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, March 18, 1893.

NEW YORK GENERAL FINANCIAL STOCK MARKET.

**The general situation** shows a few faint signs of improvement, and the general belief prevails that with easy money the reaction which is now overdue will take place. The average fall in prices in the last few months has been 8 points; the maximum 40 points. With two exceptions this is the greatest decline that has taken place since 1888. Money continues to rule very stiffly. During the past ten days there has been little or no talk of gold exports, owing to the high rates for money on this side. We have prophesied that with a weakening in interest rates gold exports would be resumed. To-day engagements were made for $1,000,000 to be shipped Tuesday. This amount was ordered before the squeeze in money, and now that rates have decreased contractors find it profitable to ship the gold without a loss. It goes to Austria. At different times during the week there were rallies of from one to three points in the market in certain active stocks. Each time it was believed that the upward movement had started. However, after the situation had been canvassed, it was seen that the advance was upon the covering of shorts. The last of these movements took place yesterday afternoon and to-day. With the short element eliminated from the market, its position will be materially strengthened. The state of trade throughout the country, in spite of bad weather and active money, is reported active. The general trend of prices has been downward. Business failures for the week were 221, compared with 219 for the corresponding time of last year. Orders for knit goods are reported the largest ever known for the season. Indications in the South favor materially large cotton acreage. Cotton declined this week ¼ and wheat 2¼c. The iron industry shows some improvement. Copper is steady at 11¾ for lake; lead firm and tin lower.

NEW YORK ELECTRICAL STOCK MARKET.

**But two stocks** in this list showed any degree of activity, and these were affected materially by the depressing influences which existed in the general market. Reference is made to Western Union and General Electric. The inactive stocks, notably the Telegraph and Telephone, received a moderate inquiry at values slightly less than ruled before the present decline. They meet with very few sales, showing that they are strongly held and from an investment point of view are not influenced materially by the money situation.

**Western Union.**—Western Union ruled steady through Monday and Tuesday, and on Wednesday succumbed to a bear attack which carried it down to 92⅝. Its decline had been about 8 points, or the exact average of the entire list. Consequently it can be assumed that the downward movement is not due to any lack of faith in the property. From the lowest point it rallied to 94⅝, the closing to-day. Its 5 per cent. debenture bonds sold at 103 to 103½, the ruling price of several weeks. It will not sell ex 1¼ per cent. dividend until March 21.

**Edison Electric Illuminating.**—This stock led a more quiet career than for several weeks past. The quotation was considerably lower than last week, ranging between 120 and 122½. In our last report we mentioned the fact that the capital is to be increased $3,500,000. In view of the proposed advance in the rate of dividends from 5 to 6 per cent. it is expected that the bondholders will wish to exercise the right of conversion. This increase of capital is for the general purposes of the company, including some conversion so far as it may now be necessary to provide for the same. All converted bonds will be canceled. Following is given a comparative statement of earnings and expenses of this company for the month of February:

| | 1893. | 1892. | |
|---|---|---|---|
| Gross | $105,778 | $77,344 | $52,884 |
| Operating expenses, including taxes | 50,795 | 36,853 | 24,794 |
| Net | 54,983 | 40,490 | 28,089 |
| January 1 to March 1 | 121,183 | 87,257 | 59,066 |
| Accrued interest on bonds | 26,750 | 18,750 | 16,666 |
| Incandescent lamps end February | 149,021 | 100,946 | 68,178 |
| Arc lamps | 1,749 | 989 | 247 |
| Motors, horse power | 3,989 | 2,192 | 800 |

**General Electric.**—After the rally to 101½ on Monday, General Electric weakened and during the remainder of the period under review ranged between 101 and 102. This was according to the programme which was outlined for the stock by the bears. There are two very distinct views in the street in regard to the property, one being that the decline was caused by pure manipulation and was unwarranted by any internal condition of the property. In substantiation of this view is cited the statement that the company earned the past year $1,500,000 above all fixed charges and the 8 per cent. dividend. The bears who form a very considerable following claim to know that the stock is being sold by insiders; that there is evidence of this which is sufficiently substantiated to warrant their keeping out a certain short line. They say Westinghouse is cutting prices to a point which, while not being helpful to itself, is certainly cutting down the profits of the General Electric Company very seriously; that the exigencies of the times will compel a reduction in the dividend before long. Dow, Jones & Co. publish the following: Drexel Morgan & Co. admit having purchased a good deal of General Electric stock. They say they consider the stock cheap at present prices and unduly depressed by people who have to borrow the stock for delivery. There is official authority for the statement that the company is in excellent condition physically and financially, and has about $4,000,000 of cash and cash assets on hand. A broker who has been having a good many selling orders in the stock says that the borrowing demand is deceptive, so far as it is intended to give the impression that the stock sold has been mostly for short account. He says it is the same old story of borrowing the stock first and making deliveries afterwards. The selling is said to be due very largely to the inability of certain houses to borrow money on the stock. It is stated that the General Electric Company will show in its forthcoming annual report a surplus of $1,500,000 or more above all its fixed charges and the eight per cent. dividends.

**American Bell Telephone.**—This stock was moderately active in Boston; its opening prices of 203½ were the highest of the week. The lowest and closing quotation was 197½. The weakness is ascribed to very pessimistic news regarding the future of the property, conditioned upon the expiration of certain of its patents.

**Edison Electric Light Company,** of Philadelphia, has declared a quarterly dividend of 2 per cent., payable March 31.

**Chicago Edison Electric Company** met Wednesday and adjourned to April 18. It is announced that the directors have, under the authorization given by the stockholders at the annual meeting, practically completed the arrangements for the issue of bonds to pay for the arc light and power purchase.

**A Correction.**—It was stated in these columns last week and was also reported in the daily press that the Sawyer-Man Electric Company had filed a notice of voluntary dissolution with Judge Ingraham of the Supreme Court. This statement is incorrect, and therefore unjust to the Sawyer-Man Company. The report should have referred to the old Sawyer-Man Illuminating Company.

**North American.**—This stock showed further weakness, going as low as 8¾. There is the most apparent indifference exhibited by insiders as to its course.

**Stockholders to Investigate.**—According to Philadelphia advices there appears to be trouble in the Pennsylvania Electric Light Company. The stockholders have appointed a committee to inquire into and report upon the reasons why the company's franchises are not proving profitable. It is claimed that about five years ago a control of the stock was sold to the Electric Trust, and that since then the company's affairs have been at a standstill. The company owns about three miles of conduits, mainly in Chestnut and Sansom streets, besides wires in other streets.

**Closing Quotations.**—The following were the closing quotations of electric stocks on Saturday, March 18, 1893, and the range for the week in New York:

NEW YORK QUOTATIONS.

| | Par. | Capital outstanding. | Lowest. | Highest. | Bid. | Ask'd. |
|---|---|---|---|---|---|---|
| American District Tel. | 100 | 3,825,000 | 54 | 55 | 54 | 56 |
| American Bell | ... | ..... | 197½ | 203 | 202 | 203 |
| Erie Telephone | ... | ..... | 45 | 47 | 45½ | 46 |
| New England Teleph'ne | ... | ..... | 56¼ | 57 | 55 | 56 |
| Mexican | ... | ..... | 90 | 100 | .... | .... |
| American Tel. & Cable | 100 | 14,000,000 | 89 | 90 | 88 | 90 |
| Central & So. Am. Tel. | 100 | 6,500,000 | .... | .... | .... | 111 |
| Commercial Cables | 100 | 7,716,000 | 185 | 185 | .... | .... |
| Gold Stock & Tel | 100 | 5,000,000 | . | .... | 170 | 185 |
| Bonds | 500 | 500,000 | .... | .... | .... | .... |
| Franklin | 100 | 1,000,000 | .... | .... | 38 | 42 |
| Mexican Telegraph | .... | 2,000,000 | .... | .... | .... | 200 |
| Metropolitan Tel. & Telegraph Co. | | ..... | .... | .... | 104 | .... |
| Metropolitan Tel.& Telegraph Co. Firsts | | ..... | .... | .... | 102½ | .... |
| Northwestern Telegraph | .... | 2,500,000 | .... | .... | 104 | .... |
| Northwestern Tel. 7's | .... | ..... | .... | .... | 108½ | .... |
| Pacific & Atlantic | ... | ..... | 50 | 60 | .... | .... |
| Postal Tel. & Cable | ... | 10,000,000 | ... | .... | 81⅜ | 82½ |
| Southern & Atlantic Tel. | 25 | 948,775 | .... | .... | 78 | 80 |
| Western Union Tel. | 100 | 94,820,000 | 92⅛ | 94⅝ | 94 | 94⅝ |
| Real estate bonds | 1,000 | 1,219,000 | .... | .... | .... | .... |
| Debenture 7's, 1875-1900 | 1,000 | 4,920,000 | .... | .... | 110 | .... |
| Collateral Trust 5's | 1,000 | 8,181,000 | 103½ | 103½ | .... | .... |
| North American | 100 | 39,767,200 | 8¾ | 9¼ | 9 | 9¼ |
| Detroit Electric | ... | ..... | 2⅝ | 3 | .... | .... |
| Edison El. Il. of N. Y. | 100 | 6,100,000 | 120 | 122½ | 120¾ | .... |
| " " 1sts | ... | ..... | .... | .... | .... | .... |
| " " Deb's | ... | ..... | .... | .... | .... | .... |
| Edison El. Ill., Boston | ... | ..... | 149½ | 150 | .... | .... |
| Edison El. Lt. Europe | 1,000 | 2,000,000 | .... | .... | 2 | 6 |
| " Bonds | ... | 30,000 | .... | .... | 80 | 85 |
| Edison Ore Milling Co | ... | 2,000,000 | .... | .... | 5 | 12 |
| East River El. Light | 100 | 1,000,000 | .... | .... | .... | 65 |
| Fort Wayne Electric | ... | ..... | . | .... | 12¼ | 12½ |
| General Electric, com | 1,000 | 30,395,600 | 100 | 104⅛ | 101½ | 101¾ |
| " " pref | ... | ..... | 112 | 114 | .... | .... |
| Debenture 5's | ... | 10,000,000 | 95 | 97⅛ | 96⅛ | 97 |
| Automatic Exhibition Co. | ... | 2,500,000 | . | .... | 3 | 5 |
| Interior Conduit & Ins. Co. | 100 | 1,250,000 | .... | .... | 62 | 65 |
| Mt. Morris Electric | ... | 500,000 | .... | .... | .... | 65 |
| N. E. Phonograph | .. | 2,000,000 | .... | .... | 2 | 4 |
| N. Y. Phonograph | ... | 2,000,000 | .... | .... | 2 | 4 |
| N. American Phonograph | .. | 2,000,000 | .... | .... | 4½ | 6 |
| U. S. Ilum. Co | .. | ..... | 20 | 25 | .... | .... |
| Westinghouse common | 50 | ..... | 33⅞ | 34 | .... | .... |
| " preferred | 50 | ..... | 47 | 48 | .... | .... |

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stocks furnished THE ELECTRICAL WORLD by C. V. Bantz, Jr., 167 Dearborn street:

| Telephone Stocks: | Bid. | Ask'd. | Electrical Stocks: | Bid. | Ask'd. |
|---|---|---|---|---|---|
| Chicago | .... | 200 | Chicago Arc Light and Power Co | .... | 118 |
| Central Union | .... | 50¼ | | | |
| Michigan | .... | 93 | Chicago Edison Co | 220 | .... |

## NEW INCORPORATIONS.

**The Reading Traction Company,** Reading, Pa., capital stock $100,000, has been formed to construct motors, cables, etc. B. F. Owen, Chas. H. Schaeffer and Wm. B. McIlvain are interested in this company.

**The La Cueva Commercial Company,** La Cueva, N. M., capital stock $50,000, has been formed to light the town of Mora by electricity, etc. D. C. Deuel, J. J. Woodworth and A. H. Whitmore, are the promoters.

**The Scranton & Carbondale Traction Company,** Scranton, Pa., capital stock $10,000, has been organized to construct and operate motors, cables, etc. The promoters are J. W. Fowler, A. N. Chandler and S. D. Petit.

**The Schuylkill Highlands Railway Company,** Norristown, Pa., capital stock $100,000, has been formed to construct and operate an electric railway. H. C. Landis, William M. Kerr and Clinton Edge are the organizers.

**The Jefferson Light, Heat, Power and Water Company,** Jefferson, Ia., capital stock $50,000, has been formed to supply electric light, etc. D. Milligan, S. C. Lee, F. M. Riley and Owen Lovejoy, are the promoters.

**The Monongahela City Street Railway Company,** Pittsburgh, Pa., capital stock $15,000, has been formed to construct and operate an electric railway. W. R. Law, D. A. Cameron and Charles Hinds are the promoters.

**The Lehigh Valley Traction Company,** Allentown, Pa., capital stock $75,000, has been incorporated to erect and operate an electric railway. Jno. K. Page, Morris L. Kauffman and Charles H. Edwards are the parties interested.

**The Chicago & Grand Marais Investment Company,** Chicago, Ill., capital stock $500,000, has been formed to operate electric light and power plants, etc. The promoters are Ed. E. Lewis, Thos. B. Lewis and Edwin C. Arnold.

**The Chester Light, Water and Ice Company,** Menard, Ill., capital stock $35,000, has been formed to operate an electric, gas, water and ice plant. Geo. L. Edwards, Wm. H. Bryan and John D. Gerlach are the incorporators.

**The Jessup Rapid Transit Company,** Scranton, Pa., capital stock $24,000, has been organized to construct and operate an electric railway. The promoters are P. B. Gilmartin, Winton, Pa., W. G. Robertson and Jas. W. Smith.

**The Meadville Street Railway Company,** of Meadville, Pa., capital stock $30,000, has been organized to construct and operate an electric railway in that place. The promoters are Geo. D. Trawin, H. H. Thompson and F. R. Syhrock.

**The Lancaster & Downington Street Railway Company,** Lancaster, Pa., capital stock $1,000,000, has been formed to construct and operate an electric railway. The promoters are A. E. Meily, S. Al. Hemch and George W. Meily.

**The Metropolitan Magneto Fire Alarm Company,** New York City, capital stock $250,000, has been incorporated to manufacture electrical apparatus. F. Martin, H. B. Lytle and H. W. Martin, New York City, are the promoters.

**The Jefferson Electric Company,** Jefferson, Wis., capital stock $20,000, has been formed to operate an electric plant. G. Grimm, G. J. Kispert, J. Reind, J. Stoppenbach, F. Stoppenbach, and O. J. Keischenssteiner, are the promoters.

**The Marshall Electric Light and Power Company,** Marshall, Mo., capital stock $30,000, has been incorporated to furnish light and power. The promoters are Thos. E. Wordell, Harry M. Rubey and Wm. E. M. Cully, of Macon, Mo.

**The Panther Valley Electric Light, Heat and Power Company,** Lansford, Pa., capital stock $10,000, has been formed to supply light, heat and power. W. D. Thomas, John E. Lauer and John A. Quinn, all of Lansford, are the incorporators.

**The Wichita Electric Railway and Light Company,** Wichita, Kan., capital stock $450,000, has been formed to operate a street railway and an electric light plant. J. O. Davidson, Arthur Faulkner, J. W. O'Neill, Wichita, Kan., and A. T. Batchelder, Keene, N. H., are the organizers.

# Special Correspondence.

## NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, March 20, 1893.

**Mr. W. T. Partridge,** manager of Waterhouse, Gamble & Co., left last week on an extended trip throughout the West and Northwest. Mr. Partridge will remain away some two or three weeks.

**Mr. Paul T. Kenney,** who formerly represented the Mather Electric Company in New York, has severed his connection with that company, and is not connected in any way with either the parent company or any of its branch offices.

**Waterhouse, Gamble & Co.** have moved their office from 45 Broadway to their factory, 302 Asylum street, Hartford, Conn. This company reports large and increasing orders for the Waterhouse arc lamp.

**The American Institute of Electrical Engineers** will hold its 75th meeting at the Institute headquarters, 12 West Thirty-first street, on Tuesday, March 21, at 8 P. M. The paper to be presented is entitled "The Cost of Steam Power Produced with Engines of Different Types Under Practical Conditions; with Supplement Relating to Water Power," by Chas. E. Emery.

**Mr. Charles T. Snedekor,** the inventor of the "Salamander" fireproof wire which has recently attracted such wide attention, sailed for Europe on the 18th inst. in order to introduce his invention there. Should Mr. Snedekor give exhibitions of the remarkable properties of his wire similar to those before various electrical bodies in this country, several of which we have reported in our columns, we have no doubt but the professional interest resulting will enable him with little difficulty to arrange for its manufacture there under as favorable auspices as in the United States. Mr. Snedekor is fortunate in entering the field at the present moment when the necessity of fireproof wires is becoming so universally recognized, and the interest in the subject which has lately been apparent in Europe will cause the undoubted merits of his wire to receive the careful consideration they deserve.

**Mr. Samuel Boardman,** president of the Bishop Gutta Percha Co., and senior member of the law firm of Boardman & Boardman, 155-157 Broadway, N. Y., died at his residence, Newark, N. J., on Tuesday, the 14th inst. Mr. Boardman was born in Manchester, England, in 1816. He came to New York in 1832, studied medicine here, and soon after being admitted was appointed surgeon at the United States Arsenal, Chattahoochee, Florida. A few years later Mr. Boardman was appointed commandant of the Arsenal with rank of captain. He remained in that position for several years, filling the offices of surgeon and commander of the Arsenal and postmaster of the station, but on account of failing health he decided to return to New York. He studied law for two or three years before resigning his post at Chattahoochee, and in 1853 came to New York, entering the office of Benedict & Boardman, which firm he soon joined as partner. Mr. Samuel Boardman was the last survivor of the old partnership. Mr. E. C. Boardman, nephew of the deceased, for several years has been the active head of the firm. Mr. Samuel Boardman in his younger days was a prominent mason, reaching the position of Deputy Grand Master of the Grand Lodge in Florida. One of his first clients in New York was Samuel C. Bishop, the proprietor of the Bishop Gutta Percha Works, who was also an enthusiastic mason. Mr. Boardman was attorney for Mr. Bishop until the death of the latter, which occurred in 1872, and afterward for Mrs. Bishop, in whose name the Gutta Percha Works were conducted until her death in 1881. Mr. Boardman continued the business until 1885, when he organized the present Bishop Gutta Percha Company, of which he remained president until his death. He was for many years a member of the Manhattan Club and of the Bar Association of this city.

## NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., March 18, 1893.

**Mr. A. F. Gerald,** president of the Waterville & Fairfield Street Railway and Light Company, was in Boston on business Thursday, March 16.

**Wm. H. Wilkinson,** Boston, Mass., reports a steady increase in the demand for his wiping device. This device is used for oiling the crank pin, ways and cross-head pin of an engine. All the prominent engine builders use these wipers, and report entire satisfaction.

**The General Electric Company** has asked that the United States Supreme Court issue an injuntion against the Germania Electric Company and the Boston Incandescent Lamp Company, both of Boston, Mass., to prohibit the above named companies from manufacturing incandescent electric lamps. In anticipation, probably, of the result, the Germania Electric Company has made an assignment,

**The Lynn Gas and Electric Company,** of Lynn, Mass. will shortly erect a new power station in Lynn. It is to be brick and iron in construction, one story high and 150 × 100 ft. in dimensions. It will be built on the company's land at the foot of Shepherd street, and cost $150,000 when completed. The plans are being prepared in Boston.

**C. S. Knowles,** 7 Arch street, Boston, Mass., who handles everything in the way of raw materials for electrical purposes, such as Tenax friction tape and splicing compound, American Chatterton compound, hard and soft rubber, porcelain, press board, rope armature paper, "Safety" rubber insulated wires and cables reports business active.

**A new electrical device** intended to obviate the whirring sounds on telephone wires has been designed by John Beattie, Jr., of Fall River, Mass. It can be attached to the ordinary telephone and will not in any way interfere with the present form of the instrument. Mr. Beattie is well known in the electrical field as the inventor of Beattie zinc.

**The Age of Street Railways.**—A bill was recently presented to the House to incorporate the Gloucester, Essex & Beverly Street Railway Company; capital $250,000. Routes are to be fixed by the authorities of the places where the road runs—Gloucester, Manchester, Essex, Wenham, Hamilton, Ipswich and Beverly, Mass. Any motive power except steam may be used.

**Railway Location Granted.**—The selectmen of Hyde Park, Mass., voted to grant a location to the Suburban Street Railway Company within the limits of Hyde Park, on West River street, East River street, Central Park avenue and Hyde Park avenue. The officials of the company were present and accepted the order. It is subject to a forfeiture of $5,000 if the company does not comply with all conditions.

**A Boston Enterprise.**—Mr. W. H. Tacker, representing a syndicate of Boston capitalists, has asked permission from Montclair, N. J., aldermen to run an electric road through the streets of Montclair from West Orange. This company is capitalized at $5,000,000 and intends to spend $750,000 in equipping the road. It also proposes to erect an electric light plant similar to those at Hoboken to supply the neighboring towns.

**Mr. Elliott O. Johnson,** formerly with the Redding Electric Company, Boston, Mass., has opened offices in the Hathaway Building, 620 Atlantic avenue, and will represent several large firms in New England. Mr. Johnson is also general selling agent for the current measuring instruments, fan motors, etc., manufactured by the Heinze Electric Company, of Lynn, Mass. He will be pleased to meet his old friends and customers at his new quarters.

**Obituary.**—In our last issue we made the sad announcement of the death of Mr. D. A. Andrews, of the prominent firm of Pettingell-Andrews Company, Boston, Mass. Mr. Andrews had gone to Washington to attend the inaguration of President Cleveland, and also to take a well deserved rest. He had hardly reached the Capitol when he was suddenly taken ill, which rapidly developed into rheumatic fever, and terminated in his death on Monday, March 13. The funeral took place from his late residence at Brookline, Mass. It was a great shock to his many friends.

**The occupants of the Hathaway Building,** situated at 620 Atlantic avenue, Boston, Mass., have for some time been uneasy, as it was supposed a firebug was at work in that vicinity. Within the past three weeks five fires have been started in that building, but were fortunately discovered in time. But their fears were greatly eased a few days since when it was announced that the firebug had been captured and placed behind the bars. The incendiary was a young lad 17 years of age in the employ of W. R. Flemming & Co., on the first floor. Three-quarters of this building is occupied by people in the electrical business.

**The Washburn & Moen Manufacturing Company,** Worcester, Mass., has increased its capital to $3,000,000. The shareholders met recently, when 19,000 shares of stock were represented. The directors urged the importance of increasing the capital stock from $2,500,000 to $3,000,000 in order to enlarge the new plant at Waukegan, Ill. The resolution was adopted unanimously. The stock will be sold at par and it is likely that one share of the new stock will be allowed each shareholder for every five shares of the old stock held. It is expected that one half payment of the subscription will be asked for April 6 and the final payment one month later.

**The proposed building** at Indian Orchard to utilize the water power for running dynamos is being discussed by the directors of the electric lighting company. Plans have been submitted for a one-story brick building above the Indian Orchard Company's mill, costing about $125,000. A committee has been appointed to confer with the Indian Orchard Company and see what arrangements can be made to secure the site and power. As the electric lighting company controls the Orchard Mills stock, the arrangement is not likely to be difficult. Still the officials say that action will be taken by the corporations individually. The plan to rebuild will be affected somewhat by the action of the street railway company; if it decides to generate its own power and put up a building on the lot recently acquired for the purpose, the electric light company would not find the demand for enlargement so pressing.

**Assignment of the Germania Electric Company.**—The following communication, bearing date of March 15, 1893, and signed by Charles A. Williams, 18 Post-Office Square, Boston, Mass., gives formal notice of the assignment of the Germania Electric Company: "Pursuant to the provisions of chapter 340 of the Acts of the Legislature of Massachusetts for the year 1887, notice is hereby given that the Germania Electric Company, a corporation having its usual place of business in Boston, Mass., has made to the undersigned an assignment for the benefit of the creditors of said company of all the property and estate of said company except such as is by law of this Commonwealth exempt from attachment, and that the undersigned has accepted said trust. A meeting of the creditors of said company will be called at an early date, of which due notice will be given. Creditors who wish to avail themselves of the benefits of said assignment are notified that they must execute the same within 60 days from this date."

**At the Boston office** of the National Electric Manufacturing Company, of Eau Claire, Wis., we have seen some large photographs of the new type of alternating dynamos, the peculiar feature of the machine being the self-oiling device manufactured only by this company. It is an arrangement which acts as a centrifugal pump, continually lifting oil from a reservoir below to the top of the journal in the centre, and distributing it both ways from the centre to the very ends of the bearings, not an occasional lubrication, but a continuous, uninterrupted flow of oil with every revolution of the shaft. It is so perfect in its mechanism and operation that new machines carrying armatures that weigh three tons run from the very start with a full load for ten hours without heating even perceptibly. Mr. H. F. Holland, who represents the company in the New England States, has recently closed several contracts for these machines, and one of 2,500-light capacity is on its way for the electric light company of Abington and Rockland.

**The Mason Regulator Company,** Boston, Mass., is the manufacturer of several regulating devices, among which might be named the Mason reducing valve. This valve is designed to reduce and maintain an even steam or air pressure. It will automatically reduce boiling pressure for steam heating coils, and all places where it is desirable to use lower pressure than that of the boiler. The Mason pump pressure regulator, the Mason pump governor, the Mason steam damper regulator, and the Mason balanced valve are also manufactured by this company. The latter is a double piston balanced valve used in connection with the speed governor; the principal advantage is in the guide for the valve stem, which is cast on the bonnet, thereby keeping the valve stem in a direct line with the stuffing box, for this reason it being impossible for the valve stem to bend and the packing seldom has to be renewed. The Mason lever valve is made essentially the same as the balanced valve with the substitution of yoke and lever with weight attached for the bonnet and knuckle joint of the balanced valve. There is no lost motion in any of the joints, a fact which those desirous of close regulation will appreciate.

## PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 31, CITY TRUST BUILDING, 927 Chestnut St.,
PHILADELPHIA, Pa., March 18, 1893.

**Mr. La Roche,** of the La Roche Electrical Works, Philadelphia, is absent in Washington on a business trip.

**Mr. H. B. Cutter,** of the Cutter Electric Manufacturing Company, of Philadelphia, has gone to Chicago on a business trip, where he expects to remain for the next two weeks.

**Messrs. Stearn & Silverman,** electrical contractors of Philadelphia, have contracted for the complete construction of the Warren and Park Street Railway Company, Warren, O.

**Mr. Charles Stanton,** of the firm of C. H. & H. Stanton, Philadelphia, has returned from Bermuda, where he has been for the past six weeks on business combined with pleasure. This firm reports doing an excellent business in office electric fixtures in Pittsburgh, where its salesman has been for the past month.

## PITTSBURGH NOTES.

PITTSBURGH, March 18, 1893.

**The Miller Electric Construction Company,** Pittsburgh, has recently removed its office from Smithfield street to 123 Third avenue, Ferguson Building.

**The People's Electric Light Company,** of Braddock, Pa., is the name of a new electric light company, organized some time ago in Braddock, Pa. At a recent meeting of the stockholders the following were elected directors: W. J. Vance, A. F. Reed, J. H. Mills, A. M. Casline, E. J. Small, Esq., R. D. Wilson and Henry Miller.

**The Iron City Electric and Fixture Company,** the successor to the Iron City Electric Company, Pittsburgh, will continue at the same address, 110 Wood street. They have issued a very neat circular to the trade, showing that they are prepared to furnish special designs of electric combinations and gas fixtures to meet the requirements of all architectural decorators and fill orders of electrical supplies of every description. They are incorporated with a capital of $10,000.

**J. L. Hayes & Co.,** 830 Liberty avenue, Pittsburgh, who manufacture table boards, cut-outs, etc., of slate and marble, although but a new firm, are doing considerable business in their line, receiving orders and inquiries from all quarters for their goods and catalogues. They report this is the result of advertising in THE ELECTRICAL WORLD. The index and contents of their catalogue mention table boards, general construction, special boards, extra fuse connections, electric report work, etc.

**The Shaver telephone** was for the first time introduced into actual operation this week in McKeesport, Pa. The new competitor of the Bell telephone is said to be giving very excellent service. McKeesport is the first town in this country where this system was brought into practical operation, and great interest is shown in its workings. An inspection committee from New Orleans is now on its way to McKeesport to examine into the system with a view of introducing it in the Crescent City. The Shaver telephone rental is $3 per month.

**The Allegheny County Light Company** has removed the last apparatus from its old plant, on Virgin alley, to the new central station, on Twelfth and Pike streets, this city. The new station has now in operation alternating current apparatus for 45,000 16-c. p. incandescent lamps and 500 arc lamps. The company formerly operated three different stations, which, however, have now all been abandoned, and all the apparatus has been concentrated in the one plant, which makes one of the largest central station plants in the country.

**The annual meeting** of the Union Switch and Signal Company was held in the Westinghouse Building, this city, last Tuesday afternoon. The reports of the president, general manager, secretary and treasurer were read, all showing the company to be in an excellent financial condition. A board of directors, consisting of the following named gentlemen, was elected: Mr. George Westinghouse, Jr., president; Mr. E. H. Goodman, vice-president and general manager, and Messrs. A. M. Byers, Thomas Rodd, W. Scott Fitz, James H. Willock and W. McConway, directors.

## WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, March 18, 1893.

**Mr. A. D. Adams** was one of the busiest men at the recent meeting of the National Electric Light Association at St. Louis. In addition to the important paper which he read he looked after the interests of the Commercial Electric Company, of Indianapolis, of which he is the efficient manager.

**W. H. Greenland,** manager of the Duluth shops of the Great Western Manufacturing Company, has been in Chicago for some days during the present week consulting with Mr. Gilman and Mr. Bain. Extensive additions to the present factory are to be started at once, and when completed will make the new works the most extensive in the West.

**Mr. Thos. G. Grier,** of Chicago, attracted much attention at the St. Louis Convention by his handsome exhibit of switches. Mr. Grier has acquired from W. B. Cleveland, of Geneva and Cleveland, O., and H. T. Paiste, of Philadelphia, Pa., both of whom are well known manufacturers in this line, the manufacturing rights of some valuable switches, and it is evident that this eclectic method will give him the control of the best in the market.

**The Bain Electric Manufacturing Company,** of Chicago, has been consolidated with the Great Western Electric Supply Company, Chicago; Western Electric Supply Company, St. Louis; Chicago Insulated Wire Company, Sycamore, Ill.; and the Phœnix Manufacturing Company, Duluth, Minn., under the title of the Great Western Manufacturing Company, with commodious factories at Duluth, Minn., where the production of electric light, power and mining machinery and systems of Forée Bain will be continued under his personal supervision. Mr. Bain will soon remove to Duluth and make that place his future home.

**Boilers at the World's Fair.**—There seems to be considerable misunderstanding in regard to the litigation of the water tube boiler manufacturers under the name of the Temporary Association against the World's Columbian Exposition for an injunction to prevent the installation of Stirling boilers. The Temporary Association was composed of six water tube boiler manufacturers, formed, it is claimed by the Stirling company, to exclude other manufacturers from exhibiting at the World's Fair. Additional space was created, for which the Stirling company applied for on equal terms with all, but were refused on the ground that the space had been promised to the Babcock & Wilcox company. The Stirling company appealed to the Council of Administration and was sustained and the contract entered into. The Babcock & Wilcox Company filed a bill for an injunction to shut out the Stirling boilers and the Master in Chancery decided in their favor. Judge Grosscup of the United States District Court reversed this decision

on the ground that the engineer in charge had no authority to make a verbal agreement. It was held that none of the essential allegations of the Babcock & Wilcox company were established, and the injunction was denied with costs. In consequence the Stirling company is to make an exhibit, and four Stirling water tube boilers are being erected in the main boiler room of Machinery Hall.

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CINCINNATI, March 18, 1893.

**The Siemens & Halske Company's** agents at Cincinnati, O., have sold a 750-h. p. generator to the Consolidated Street Railway Company, of Cincinnati. This machine makes 100 revolutions per minute and is direct connected. They also have several other important orders on hand, and report business very satisfactory.

**Houliston & Co.,** Cincinnati, are now successors, since Jan. 1, to Houliston & Hubbard, Mr. O. M. Hubbard withdrawing to engage with the Central Thomson-Houston company as a salesman. The new firm will continue the business as electrical contractors and dealers in supplies and patent specialties, 164 Plum street.

**Edmond A. Sarran & Co.** have bought out the Central Chandelier Company of Toledo branch located 173 West Fourth street, Cincinnati, and will continue the business of handling combination electric fixtures, in connection with their business as dealers in electric motors, dynamos and supplies and electrical specialties.

**The Wm. Oesterlein Clutch Works,** Cincinnati, O., have just shipped to Oshkosh, Wis., five 36 to 40-inch pulleys; Dayton, O., 18-inch pulley; Cincinnati Coffin Company, 28-inch pulley; Charlottesville (Va.) Electric Light and Gas Company, two 30-inch 150-h. p. couplings; Lodge & Davis, 50 sets per month, and a large number of small orders to different parts of the country.

**D. J. Hauss,** 51 Pike Building, Cincinnati, O., electrical engineer and contractor, manufacturer of electrical specialties and dealer in electrical supplies, has increased his facilities for manufacturing incandescent and arc lamps, batteries, switches, cut-outs, clusters, brackets, electric light power, railway, mining and steam plants, and to contract for wiring and repairing of electrical apparatus and all kinds of electrical goods for physicians' use.

**The Electrical Railway Equipment Company** is very busy in all its departments, and is bringing out some new railway specialties for overhead line work, one of which is the new trolley harp. The trolley wheel will be surrounded by five small steel wheels, inclosed in a brass frame, acting similar to a ball bearing, thus giving it a very easy motion and lasting a long while, having but slight friction The company is also making some improvements on its trolley poles.

**F. A. Kelley,** with the General Electric Company, Cincinnati, O., has just returned from Florida, having spent some time on Cumberland Islands, Ga., for his health. While there he improved the opportunity to do some hunting, bagging several alligators that did not get out of reach of his gun in time, also a large number of wild ducks and other game. J. M. Hunter is organizing a company to establish an electric light and street railway plant, with $500,000 capital, on Cumberland Island, Ga., and is now at the Emery Hotel, Cincinnati, O.

**The Wm. Powell Company,** Cincinnati, O., finding its present quarters entirely too small to meet the demands of the growth of its business, is now building a large factory, No. 225 to 231 Spring Grove avenue. The building will be L shaped. 118 feet front and 200 feet deep, and is being built of Findlay pressed brick, trimmed with sandstone, thus making a very handsome factory, which will be equipped with the latest appliances and improvements. The Jenney motors and dynamos and a 150-h. p. engine will furnish power. The company expects to occupy its new quarters by the first of May.

**The Cincinnati, Covington & Newport Railway Company** is building a new power house in Newport, putting in a 4,200 h. p. Westinghouse machine. They now have a 1,400-h. p. Brush and Westinghouse generator and will put on their road 60 new cars and equipments for the single trolley system. They are changing their entire track, some 40 miles being laid on a very solid foundation, first of six inches of crushed stone, then heavy oak ties 16 inches apart, on which are placed 90-pound steel rails from the Pennsylvania Steel Company. This plant when complete will cost fully $30,000,000. John W. Daugherty, an experienced contractor, has the work in charge.

**The Card Motor and Dynamo Company,** on account of the increase in its business, is pushing forward as rapidly as possible its new factory, corner of Hunt street and Broadway. This factory will be 175 feet on Hunt street, 86 on Spring street and 36 feet on Broadway, being L in shape and three stories high. The office will be on Broadway and Hunt street, over the show-room, which is 36 by 26, back of which will be the testing room, 55 feet long, the rest of the building being devoted to the shop work. It will be heated throughout with forced hot air and will have the very latest modern improvements suitable for the business. As they are now very much crowded at present in their old quarters they are very anxious to get their new building up, when they will remove about June 1 next.

**The Bradford Belting Company,** Cincinnati, O., on account of increase in its business, is looking for larger and better quarters for its belt factory where it can be under one roof, as it is now scattered through several buildings. It has recently sold one of the largest leather belts in the world to the Brooklyn City Electric Railway Company, being 116 feet long, 72 inches wide and weighing 1,800 pounds. One hundred and twenty hides, or several car loads of Texas steers, were required to make it. Two 56-inch belts, each 100 feet long, have been shipped to the Louisville Street Railway Company; three 48-inch by 100 feet long to the Covington & Newport Street Railway Company, and two 27-inch by 95 feet to Fort Wayne Electric Company.

**The General Electric Company** has just equipped for the Crump Street Railway, of Columbus, Ind., four single equipments and generators, 130 h. p.; a city plant at Bowling Green, Ky., consisting of one 50-light T.-H. dynamo and equipments with four miles of street circuits, etc.; also for the Miami Powder Company, Xenia, O., 270-h. p. and 85-h. p. generator, 125-h. p. M. P. type motor, one 65-h. p. motor, one 35, three 25, one 10, three 5 and three 3-h. p. motors. This is the first and only complete plant for powder works driven by electricity, and has been in operation for two years, giving satisfaction in every respect. Mr. E. J. Schroder, formerly with the T.-H. company, Boston office, has accepted a position with the company at this office and will take charge of the mining department.

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CLEVELAND, O., March 18, 1893.

**Plans and surveys** are to be made at once for the projected elevated road to Euclid Heights.

**Plans** for the proposed elevated railway from the square to the East End are being rapidly pushed.

**The Messrs. Scofields** have put before the Council an application to run their street railway from the southwestern limits of the city to Gordon Park.

**One of the four** remaining electric light masts in the city is to be removed and its place taken by lamps distributed along the street. It will be taken down by sections.

**Messrs. Chas. Steese,** W. K. L. Warick, W. B. Humberger and Otto E. Young propose to build a street railway between Massillon and Navarre, a town five miles south.

**Mr. Isaac W. Morris,** formerly chief night operator in the Western Union Telegraph office of this city, has been promoted to chief day operator, to succeed the late O. A. Gurley.

**The East Cleveland Company** is endeavoring to recover $15,000 worth of bonds held by Dr. Everett, its former president. In answer he has filed a counter claim of some $25,000 for unrequited services.

**The Ford-Washburn Storelectric Company,** of Cleveland, O., has just taken an order from the Sperry Electric Mining Company, of Chicago, by C. J. Swift, business manager, for batteries to deliver 1,000 ampères for 30 consecutive minutes.

**The Universal Electric Company,** Cleveland, O., has added to its factory some new improved mercury pumps and other improved machinery for the renewing of old lamps, which has grown to quite a large business. It is also turning out extra fine tempered coppered castings for segments and commutators.

**Mr. Frederick A. Scheffler,** superintendent of the Brush Electric Company, of Cleveland, O., has tendered his resignation, to take effect April 1. Mr. Scheffler has for several years past been actively identified with the manufacture of electrical apparatus, and for a number of years previous was engaged in the production of steam engines and boilers. His address, after the first of April, will be "Passaic, N. J., care of E. K. Rose."

**The Electric Equipment Company,** Cleveland, O., has opened its office at 153 St. Clair street, with A. E. Burland, formerly superintendent of the Fisher Electric Company, of Detroit, and George W. Gurnett, as proprietors. They are contractors for electric light plants, electric wiring and marine work. They have put in an isolated plant in the residence of J. H. Wade, Euclid avenue, consisting of 250-light Fuller dynamo and J. T. Noyes 30-h. p. engine.

**The Elliott Electric Company,** of Cleveland, O., recently incorporated for manufacturing dynamos, motors and for general electrical repairing, has elected as officers W. H. Elliott, president; S. K. Elliott, vice-president, and J. E. Elliott as secretary, treasurer and general manager. This firm having recently enlarged its factory on account of increasing business, still finds that it has hardly enough room to keep up with the orders, and is often compelled to work nights.

**Representatives of the various street railway companies** in town recently met in the office of F. De Hass Robinson, president of the Cleveland City Cable Railroad Company, to confer about the joint expense of constructing a new loop in view of the increase in the number of cars to be run. This is very desirable, as at the present time the four tracks on Superior street, and the loop around Bank, Lake and Water streets, are very much crowded in the morning and evening, as many as nine cars a minute passing over them at certain times.

**The Brush Electric Company,** Cleveland, O., has just shipped to Petersburgh, Ind., for the Petersburgh Light, Power and Water-Works Company a 50-light arc, and a 600-light alternating machine; the Plant Investment Company, Fort Tampa, Fla., 45 light arc and 600-light alternating; Savannah (Georgia) Real Estate, Loan and Building Company, two 60-light arc and equipments; Singer Machine Company, Pittsburgh, Pa., 400-light incandescent, direct; Scranton (Pa.) Electric Light and Heat Company, 60-light arc; Fulton Worsted Mills, Fulton, N. Y., 60-light arc; Cooper Block, Denver, Colo, 835 incandescent direct; Illinois Central Railway Company, Chicago, a complete plant 3,300 lights direct current.

**The Brush and Thomson-Houston** lighting companies in this city have combined under the name of the Cleveland General Electric Company, and will shortly begin work upon a new power house on Canal street to take the place of the two at present in use. The power house is to be large enough to accommodate 10,000 h. p., and it is expected that the company will invest during the next 18 months or two years from $500,000 to $600,000 in its plant. It expects to be able to use the new building next fall. Col. Myron T. Herrick has resigned the presidency of the company on account of the pressure of outside business. His place will be taken by Mr. Horace E. Andrews, while Colonel Herrick takes the position of vice-president. The new company expects to provide the entire city with electric lights and power.

**The consolidation** of the various street railway companies in town has been much discussed of late. There apparently has been some basis for the rumors, as last week the consolidation of the Broadway and Newburgh road with the East Cleveland was announced. This consolidation was brought about principally through the influence of Messrs. Everett, Wason, Peck and Bradley, of the East Cleveland Company, and Messrs. Andrews and Stanley, of the Broadway and Newburgh. H. A. Everett is mentioned as the probable president of the combination. The deal is practically settled, more than the necessary two-thirds of the stock holders having subscribed to it, but the final arrangements have not as yet been completed. It is rumored that the combination will also include the Woodland Avenue & West Side road. This come about through the purchase of a large block of Woodland Avenue stock by J. H. Wade, of this city, whose influence will undoubtedly be in favor of consolidation. In fact, in many instances, stock in both the East Cleveland and Woodland Avenue roads are held by the same individuals, which, of course, renders combination more easily attainable. The combination will be heavily capitalized some reports placing the new stock at as high an amount as $10,000,000. A four cent fare, with transfers to all the routes, is contemplated.

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TACOMA, Wash., March 8, 1893.

**The Tacoma Light and Water Company's** extensive electric light, gas and water plant, which was recently offered for sale to the city for $1,750,000, is reported to have been purchased by Nelson Bennett, a Tacoma capitalist.

**The Everett & Snohomish Street Railway Company** now has the following officers: Geo. M. Nelson, president; Melvin Swartout, vice-president; W. de F. Edwards, secretary; R. M. Mitchell, treasurer. The company will build a railway line from Everett, Wash., to Snohomish.

**The Sunset Telegraph and Telephone Company** is making preparations for the extension of the lines of the Inland Telephone Company and the Oregon Telephone Company from Spokane, Wash., to Portland, Ore. A number of poles are on hand and a boat has been built to reach inaccessible points along the bank of the Columbia River, which the line follows for some miles. Leaving Spokane the new line will be built via Colfax, Pomeroy, Walla Walla, Wallula, Wash.; Umatilla, Arlington and The Dalles, Ore., to Portland, a distance of 181 miles by rail, but about 32 miles less by this route. When this line is completed the Sunset company, with the assistance of the above lines, which it controls, will be enabled to hold telephone communication between Everett, Wash., and the Wardner mines, covering a distance of about 800 miles.

## CANADIAN NOTES.

OTTAWA, March 18, 1893.

**Selkirk, Manitoba.**—It is expected that the electric road between Selkirk and Winnipeg will be in operation by September.

**The Pembroke (Ont.) Electric Light Company** is applying for power to increase its capital stock from $20,000 to $50,000.

**Fredericton, N. B.**—A proposition has been submitted to the corporation to light the city with incandescent electric lights. The proposition involves the selling of the plant to the city.

**The Ontario Government** has issued a charter to the Woolley Electrical Appliance Manufacturing Company for the purpose of manufacturing the Woolley electromagnetic apparatus. Capital stock, $25,000.

**Letters patent** have been issued by which the total capital stock of the Chaudière Electric Light and Power Company (Limited) is increased from $500,000 to $1,000,000 and the undertaking of said company extended.

**The Hamilton Electric Light and Power Company** held its annual meeting recently. Among other matters of business transacted was the confirmation of a bylaw authorizing an increase of the capital stock of the company to $300,000.

**Cote St. Antoine** will have a high level electric railway Mr. D. Yuile and his syndicate will build it, having accepted the propositions of the Council. It will be started by June and run in a roundabout way to a point near the Athletic Club House.

**The Metropolitan Street Railway** of Toronto is applying for power to extend its lines to Lake Simcoe and to the city of Hamilton. Application is being made by a rival company, now seeking incorporation, for power to construct a line of electric railway from Toronto to Lake Simcoe.

**Quebec.**—The control of a valuable water-power on the Montmorency River above the falls has been purchased by a party, who intends to form a company with a capital of $250,000 to furnish electric light and motive power to the city and to railways, etc., in opposition to the Quebec & Levis Electric Light Company.

**The Toronto (Ont.)** street railway has given a first mortgage on its property for $4,550,000 to Messrs. Geo. A. Cox and R. B. Angus. The company will use the money in the conversion and construction of the road and in new rolling stock, etc. The deed is said to be the largest mortgage that has ever gone through the Toronto office.

**Kingston, Ont.**—The Committee on the Electric Street Railway has agreed on the following: "We recommend that the street railway company be granted a forty years franchise for the use of the streets now occupied by it; the said company to pay the city 5 per cent. on all yearly gross earnings in excess of $20,000; the corporation to keep the streets in repair."

**Berlin, Ont.**—The Berlin & Waterloo Street Railway Company is applying to the Ontario Legislature for a charter empowering the company to construct and operate works for the production of electricity, and the application thereof to the running of the railway of the company, and generally for the production, sale and distribution of electricity for purposes of light, heat and power.

**The St. Catharines (Ont.) Port Dalhousie & Thorold Electric Railway** is applying to the Ontario government for a charter to construct and operate lines of street railway in the municipalities of St. Catharines the villages of Merritton and Port Dalhousie, the township of Grantham, the town of Niagara and the township of Niagara in the county of Lincoln, and the town of Thorold in the county of Welland in the province of Ontario.

**Halifax, N. S.**—An important document has been registered in Halifax in which the Nova Scotia Power Company transfers all the street railway track, stables, cars, plant and charter, and also property at the south end, including wharf property and the electric light station and plant thereon, to the Old Colony Trust Company, of Boston, as security for the issue of sixteen hundred bonds at $15 each.

**Port Arthur.**—Notice is given that the Corporation of the town of Port Arthur will apply to the Legislature of Ontario at its next session for legislation to enable the town to rent any surplus electrical or other power that the town may have, to any person or corporation for any purposes whatever, and also to enable the town of Port Arthur to do its own municipal electrical lighting, and supply electric light for domestic and commercial purposes.

**The Toronto Electric Light Company** held its annual meeting recently and elected these directors: Messrs. A. H. Campbell, W. H. Howland, S. F. McKinnon, Henry M. Pellatt, Samuel Trees, Thomas Walmsley and Hugh Blaine; J. J. Wright, manager. After the meeting the board met and elected the following officers: A. H. Campbell, president; W. H. Howland, vice-president. The report shows that after the payment of quarterly dividends at the rate of eight per cent. per annum, $25,000 was added to the reserve fund, which now amounts to $45,000.

**The Canadian General Electric Company** has written to the Corporation of London, Ont., that it proposes to establish works in London for the production and supply of electricity for the purposes of light, heat, power and electric energy for all purposes. It applied for the authority of the Council to construct and operate a system and to string wires on the poles of the Forest City Electric Company and the Ball Electric Light Company, and, in case these companies refused the privilege, to erect poles for its own use. The authorized capital of the company is $2,000,000; paid up, $1,400,000.

## ENGLISH NOTES.

*(From Our Own Correspondent.)*

LONDON, March 1, 1893.

**Westinghouse Company and Their Three-Wire Patent.**—At the last meeting of the Brighton Town Council it was reported that a letter had been received from the English Westinghouse company, threatening them with an injunction for infringing Dr. Hopkinson's three-wire patent. The Town Clerk was empowered to reply that the corporation were not infringing the patent in question, and that the system they contemplated adopting did not involve the use of two dynamos in series and was thus essentially dissimilar to the one concerned in the recent action brought by the Westinghouse company. Similar letters have also been received by the Dundee and Glasgow municipalities.

**Municipal Electric Lighting.**—At a recent special meeting of the Leicester Town Council the report of the Gas Committee with reference to the proposed electric lighting scheme was discussed at considerable length and with considerable heat. In response to invitations, 17 tenders had been sent in, and the committee recommended the acceptance of one by the Brush company for £27,000, for an alternate current transformer sub-station system. A definite decision was, however, postponed for a month. The latest figures with regard to the Bradford station continue to show a marked improvement upon previous ones. The current sold during the last half of 1892 brought in 30 per cent. more revenue than for the corresponding period of 1891. Since the central station came into operation in the autumn of 1889, it has wiped out

the initial losses, paid the regulation amount to the sinking fund and for interest, and has now made a total clear profit of £300. The number of pounds of coal burnt per unit has now been reduced to 10.1 and the cost of coal per unit to .42d. It should be mentioned that the coal employed costs under 10s. per ton and is of a somewha poor character.

# News of the Week.

## THE ELECTRIC LIGHT.

**Morgantown, Va.,** is to have electric lights.

**Knoxville, Tenn.,** has decided in favor of electric lights.

**Clayburne, Tex.,** is to have an electric light plant at a cost of $75,000.

**The Canon City (Colo.) Electric Light and Power Company** is preparing to double its plant.

**Laurel, Md.**—The new electric light plant has been placed in operation and is now working successfully.

**Waterville, Ore.,** has leased the electric light plant and water works and will operate it the following year.

**The Napoleon (O.) City Council** has advertised for bids for the construction of an electric light plant and water-works.

**The Portland (Ore.) City Council** has passed an ordinance authorizing the sale of the city's electric light plant to the Portland General Electric Company.

**A Saw-Mill Electric Lighting Plant.**—The Albion Lumber Company, of Albion, Cal., has just completed its incandescent lighting plant for the lighting of its large saw-mill, lumber yard and store. Light is furnished by a United States dynamo of 300 light capacity, coupled direct to an 8 × 12 Woodbury engine making 325 revolutions per minute. The plant is used for the all-night lighting of the mill and lumber yard, and gives satisfaction in every respect. Lamps of the Sawyer-Man pattern of 16 c. p. each are used, and are distributed throughout the lumber yard on poles 16 feet high and 40 feet apart.

**Rochester, N. Y.**—Work on the new plant of the Citizens' Light and Power Company is progressing as rapidly as possible in consideration of the prevailing weather. The tail race is practically completed. The race is cut to a level with the river and gives a head of 90 feet to the water from Brown's race. The estimated horse power from the water privileges is 2,000, and it is the company's intention to have 2,000 h. p. from the steam engines. The race is 13 feet wide, and will take the water from Platt street sewer after it falls to the flats. The tail race will be covered and perfect ventilation is provided for by leading the air from it to the chimney of the furnaces. The chimney will be 150 feet high and 14 feet square. The power house is to be two stories in height and the boiler house one story.

## THE ELECTRIC RAILWAY.

**An electric railway** is to be built between Allentown, Pa., and Reading.

**Electric Roads for Staten Island.**—The State Railroad Commission has approved the application of the Staten Island Belt Line Railway Company for a change of motive power from horses to electricity.

**The Cincinnati (O.) Board of Aldermen** has granted a franchise for "Route 25" to Albert L. Johnson, C. R. Grover, F. Hempy, L. A. Russell and Frank N. Wilcox, on the ground that all other bids received were invalid.

**The Reading Traction Company** has been formed and chartered with a capital of $100,000. The design of the company is to erect a plant and run the street cars by electricity. B. F. Owen, the president of the Reading City Passenger Railway Company, has made the remark, "We are determined to have the trolley built this summer."

**The Peninsula Electric Railway, Electric Light and Power Company** is seeking incorporation by a bill introduced into the Delaware House. The company asks the right to run lines of electric railway the whole length of the State, with branches to where it may see fit, and to establish electric lighting plants in the towns along its route.

**The work of erecting poles** for the overhead construction is rapidly proceeding on the Baltimore Traction Company's North Baltimore line, in spite of considerable opposition on the part of some down-town merchants who object to having the poles planted on their sidewalks. The track construction will probably begin as soon as the condition of the ground will permit.

**An Electric Mail Route.**—Arrangements for carrying U. S. mails from Cincinnati to Station E, Ludlow Grove, Elmwood Place and Carthage by the Main street electric line have been completed. The mails have hitherto been transported by means of the C. H. & D. R. R., but the change was made to afford the residents of the above mentioned suburbs a more frequent delivery.

**The Consolidated Construction Company** is the name of a syndicate which has obtained control of all the street railways of eastern and northern New Jersey. John D. Crimmins, of New York, and B. M. Shanley and James Smith, Jr., of Newark, are the parties interested. The main office will be located in New York. Several hundreds of street railways will be controlled.

**The Rahway (N. J.) Common Council** has granted a franchise to the Rahway Electric Street Railway Company. The route runs through the principal streets and to Woodbridge, Boynton Beach, on the Sound. The Canda company, of Carteret, N. J., is also to build an electric railway, and it is said that an effort will be made to unite the two roads. Both will be built this summer.

**Port Huron, Mich.**—An electric railway along the west shore of the St. Clair River now seems an assured fact. A company has been organized, consisting of L. A. Sherman, H. Howard, J. H. White, F. L. Wells, S. L. Boyce and H. Sparling, to build an electric railway to Marine City, a distance of 20 miles. In time it will probably be extended to Algonac and from there, possibly, to Mt. Clemens and Detroit.

**The equipment** of the Fond du Lac Street Railway, Light and Power Company, of Fond du Lac, Wis., has been awarded to the Great Western Manufacturing Company, of Chicago. The lighting plant will include 100 2,000-c. p. arc lights and 4,000 incandescent lights. The street railway equipment consists of 10 miles of line and 20 motor sets. The work will be commenced at once and will be in full operation in the summer.

**Cincinnati, O.**—The corporation counsel at the request of the Board of Legislation has prepared a bill to provide that hereafter ordinances establishing street railway routes shall prescribe all the rules and conditions, including rates of fare. The grant shall be made to the highest cash bidder, all bids to be accompanied by a $50,000 certified check. The grantees are also to pay annually through the city five per cent. of gross earnings, and all grants are limited to 25 years.

**To Connect Paterson and Jersey City.**—The Acquackanonk Township Committee has granted the privilege to the Passaic, Rutherford & Carlstadt Electric Railway Company to run its line through the township. The new route will start at the Lake View Station and run from there along Crooks avenue to the Erie station at Clifton, and thence through Central avenue to connect with the Passaic City line. This road is to be a section of the system of which the Central Electric Railway of Paterson is to be a part, and the whole road when completed will connect Paterson and Jersey City.

**Electric Railway Problems.**—In addition to the Electric Railroad bill approved by the Consolidated Railroad Company two other general bills have just been introduced into the Legislature at Hartford. One, which is said to have the support of the mayors of several Connecticut cities, puts no restriction on the carrying of freight by the electric roads, and makes the Superior Court, instead of the Railroad Commission, the authority to which appeals may be taken. The other bill has been drawn up by ex-Gov. Bulkeley. It provides that no electric street railroad shall be more than twenty miles long, and can carry freight only when it does not occupy a public highway. Local authorities have control of its laying out on a public highway, otherwise the Railroad Commission.

## LEGAL NOTES.

**Stipulation on Telegraph Blank Void.**—The Supreme Court of North Carolina lays it down that a stipulation on a telegraph blank against liability for mistake or delay in the transmission of an unrepeated message is void. So, also, is a stipulation limiting liability, unless specially insured, to 50 times the price paid for transmitting the message. (Brown *v.* Postal Telegraph Cable Company, 16 Southeastern Reporter—179.)

**Injuries from Climbing Pole.**—In Georgia the Supreme Court lays it down that where a person climbs a pole which supports an electric wire, taking with him a wire to throw across the one on the pole, and does this without permission from the company whose system he has thus entered upon, and, by reason of the contact of that company's wire with the "feed" wire of another company, is injured, he cannot recover from the latter company.—(Augusta Railway Company *v.* Andrews, 16 Southeastern Reporter, 203.)

**Privileges of Street Railway Company Extend to Its Lessee.**—A city passenger railway has been leased for a term of years, and operated and managed exclusively by its lessee company, which had all the powers and authority of the lessor, except the sole reserved franchises to be a corporation, and in addition had its own express franchise, to make contracts and lease and operate roads, and furnish motive power. By city ordinance the city lessor company was authorized to construct the necessary appliances for the overhead electric system. The lessee company was organized at a later date with charter power to use the overhead system with consent of the council. The court held that, though the ordinance named only the lessor company, the lessee company had as full power thereunder as if it also had been named therein.—(Reeves v. Continental Ry. Co., Sup. Ct. of Penn., 25 At. Rep. 516.

**Erection of Telegraph Poles.**—The New York Supreme Court decides that Laws 1848, c. 265, as amended by Laws 1853, c. 471, which gives the consent of the State to the erection of telegraph poles in highways, was only intended to protect telegraph companies from indictment for maintaining a public nuisance in so doing, and gives them no right to erect such poles without the consent of the owners of the fee in the highways. The court also holds that the occupancy of a highway by the poles of a telegraph or telephone company is not one of the ordinary and legitimate uses for which highways are established, and is the imposition of an additional burden on, and the taking of, the property of the owner of the fee, which enables him to maintain an action to compel the removal of the poles, and to recover possession of the premises occupied thereby, with damages, where such occupancy is without his consent, and without compensation having been previously made him therefor.—(Eels *v.* American Telephone and Telegraph Company, 20 New York Supplement, 600.).

## MISCELLANEOUS NOTES.

**A recent number** of the *Crown Vista*, of Pasadena, Cal., contains several flattering notices of Mr. A. W. Decker, consulting and supervising electrical engineer of the Redland Electric Light and Power Company. It was under Mr. Decker's supervision that the large Westinghouse water power plant at San Antonio was installed, and he is now in charge of the construction of the Lowe Mountain Electric Railway.

**Struck by March Lightning.**—During the severe storm of March 14th, the Stonington line steamer New Hampshire, on her trip from New York to Stonington was struck by lightning. Fourteen of the saloon windows were shattered, and glass in other parts of the boat broken. A bunch of electric lights suspended on the rear deck were also smashed, and the sheathing around the back (?) was torn off and scattered about. It was found that the electric light wires had carried the current all over the boat, but the damage done was very slight.

**A New Cornell Publication.**—A treatise on "Alternating Currents," by Bedell and Crehore, is brought out to day by the W. J. Johnston Co., New York, and by Whittaker & Co., London, and forms an octavo volume of 325 pages. Owing to the mathematical nature of the work and the elaborately prepared plates and diagrams, the book has been six months in going through the press. It is entitled "Alternating Currents: An Analytical and Graphical Treatment for Students and Engineers," and is divided into two parts, of which Part I. treats the subject of circuits containing resistance, self-induction and capacity analytically, according to the general method given by the authors in a paper before the American Institute of Electrical Engineers at their annual meeting in Chicago last June. Particular cases are brought up and discussed separately. Part II. treats the subject graphically and gives geometrical solutions, based upon the analytical solutions in Part I. for combinations of series and parallel circuits, containing resistance, self-induction and capacity. This portion of the work takes up various problems in turn, and is of particular value to the engineer. The subject is brought out step by step, and the various principles so clearly developed in logical sequence that a clear and comprehensive grasp of this complex and little explored branch of electricity is readily acquired by the student. Although no copies of the book have as yet been issued, the work has already been adopted at the University of California, University of Illinois and Purdue University, as well as at Cornell. The work immediately takes its position as an authority because of the numerous scientific papers by the authors which have been appearing in England and France, as well as in this country, and which have received favorable editorial comments in the leading journals, here and abroad. For the short time that Dr. Bedell and Dr. Crehore have been connected with the university since graduating at Yale, they have made many valuable contributions to science, and have done much to add to the reputation of Cornell.—*Cornell Daily Sun*, March 6, 1893.

# Industrial and Trade Notes.

**The Weston Electrical Instrument Company,** of Newark, N. J., has recently manufactured 30 station ammeters of 1,500 ampères capacity. This company has been asked to make a 25,000-ampère ammeter, which, when completed, will be the largest ammeter ever made.

**The Mason Electric Company,** 10 and 12 Vandewater street, New York City, has sent out a neat pamphlet descriptive of Mason's new battery system of electric lighting and power. The advantages of this system are set forth and illustrations of the batteries, motors and other apparatus are given.

**The Ansonia Electric Company,** formerly the Electrical Supply Company, Chicago, has in preparation a book of tables and other information of use in electrical work, which book, we are informed, will be found unusually valuable. Some original tables of great value have been obtained at considerable cost.

**The Ansonia Electric Company,** formerly the Electric Supply Company, corner Randolph street and Michigan avenue, Chicago, finds its electric radiators and heating apparatus in demand at this season of the year when it is hardly cold enough to keep up the heavy fires of winter and not warm enough to dispense with them altogether.

**The Electrical Supply and Construction Company,** Bay City, Mich., W. F. Hold, manager, has entered upon the new year well equipped for its increasing business. This company deals in electric dynamos and motors for all purposes, electric heating apparatus, electric fans, incandescent lamps, fixtures and supplies, electric bell work, etc.

**The new and palatial private car** of President McLeod of the Philadelphia & Reading Railroad, built by the Pullman company, is equipped with the Johnson switches, manufactured by the Interior Conduit and Insulation Company. The Central Electric Company are the Western agents of these switches and also for Okonite wire, with which the car is also wired throughout.

**It is not often** a manufacturer has to beg the indulgence of its patrons. The demand for the Straight Line indicator and reducing wheel has been so large that Hine & Robertson, 57 Cortlandt street, N. Y., announce to their many patrons that additional machinery is being put in operation and in a short time they hope to catch up with their present orders and to be more prompt in filling future ones.

**Ball Engines.**—The Casa Alameda Hotel, Sixty-third street and Columbus avenue, New York, will be furnished with power by two 80-h. p. Ball engines, built by the Ball Engine Company, Erie, Pa. The Tampa Street Railway and Power Company, Tampa, Fla., have ordered a 200-h. p. Ball cross compound engine from J. W. Parker & Co., Philadelphia representatives of the Ball Engine Company, Erie, Pa.

**A Chance to See the World's Fair.**—Hine & Robertson, 57 Cortlandt street, N. Y., who are the largest handlers of Eureka packing, have arranged with the company to give to the engineer who guesses nearest to the number of admissions to the World's Fair on July 4, $200 in gold. In each box of Eureka packing will be placed a guess certificate. This is a good opportunity to visit the World's Fair free of cost, and every one knows the Eureka packing.

**The Wrought Iron Bridge Company,** of Canton, O., and 136 Liberty street, New York City, has completed the structural iron work for the power house of the Syracuse Gas and Electric Light Company. The building is three stories high and fireproof throughout, the floors being supported on steel beams and columns and brick arches. There is also an electric crane for handling machinery built and erected complete by the Wrought Iron Bridge Company.

**The Phœnix Iron Works Company,** of Meadville, Pa., reports among its sales for March the following Dick & Church tandem compound engines: Carnegie Steel Company, Limited, Pittsburgh, Pa., two condensing engines of 150 h. p. each; Gokey & Sons, Jamestown, N. Y., two non-condensing engines of 150 h. p. each; Trumbull Electric Railway Company, Warren, O., one non-condensing engine of 150 h. p.; Salt Lake City (Utah) Electric Light Company, one non-condensing engine of 115 h. p.

**Queen & Co.,** Incorporated, Philadelphia, report a steady demand for their standard portable testing resistance sets. This applies especially to "No. T 305" which is recognized as a most efficient portable apparatus for practical work. An enthusiastic purchaser writes: "It is the best portable set I have ever used or worked with and I consider any electric light or railway plant incomplete without one. The galvanometer I find works well even in close proximity to the intense magnetic fields of our dynamos."

**The Chapman Valve Manufacturing Company,** Indian Orchard, Mass., has issued for the use of its patrons another of its substantially and handsomely bound catalogues describing the various well known types of valves which this company manufactures. More than half of the book, however, is given up to interesting matter and data on steam, electricity and refrigeration, and an engineering appendix, which is unusually complete, comprising 150 pages of tables, practical rules and other matter of great value to engineers and practical men.

**The Ashcroft Manufacturing Company,** 11 Liberty street, New York City, has issued a handsomely bound publication of 134 pages describing the Tabor improved steam engine indicator, which is now known not only all over this country, but everywhere where there is a demand for thoroughly reliable steam indicators. In addition to matter telling what an indicator is for and how to use it, a large number of diagrams are given showing cards from different types of engines, and a series of tables which have received favorable comment from many leading engineers.

**J. B. Crousi,** formerly vice-president of the Standard Carbon Company, and H. A. Tremaine, superintendent of the same, have severed their connection with the Standard Carbon Company, and have a plant in course of construction at Fostoria, O., where they will have the advantages of excellent shipping facilities and free natural gas. It is their purpose to construct a plant that will be as near perfection as money, skill and experience can make it. H. A. Trumaine brings to the business an experience of great value, and J. B. Crousi is well known to the electric light fraternity. They expect to be in the market with goods the coming fall, and will manufacture everything in the carbon line, viz., every description of electric light carbon and battery materials of all kinds.

**Mr. T. J. Murphy,** of 136 Liberty street, New York City, whose slate works and factory are at Fair Haven, Vt., has been crowded with orders of late for marble and slate switchboards. The following are only a few of the many orders he has recently filled: Marble switchboards: Mills Building, Metropolitan Life Insurance Company Building, *Mail and Express* Building, Western Electric Company, New York City; Milton (Conn.) Opera House; Columbia Theatre, Brooklyn, N. Y. Slate switchboards: R. H. Macy & Co., Manhattan Storage and Warehouse Company, Ehrich Bros., Arnold, Constable & Co., *Herald* Building, Stern Bros., Empire Theatre, Stewart Building, *Times* Building, *Tribune* Building, *World* Building, New York City; Betts Building, Drexel Building, Philadelphia; Trenton (N. J.) Street Railway, Cayadutta Street Railway Company, Johnstown, N. Y., etc.

**A World's Fair Bureau.**—We wonder if there be many who have not experienced that feeling of unrest and lostness that discourages a fellow when he arrives at his journey's end, and with grip in hand finds himself standing upon the cold, hard and unsympathetic curbstone just outside the depot. Some moving spirit connected with the Ansonia Electric Company has evidently been through some such experience and they have in the largeness of their soul (another proof that corporations do have souls) determined that none of their electrical friends who intend visiting the Fair shall be thus stranded in a strange city. We are in receipt of a copy of a notice which they have mailed to all their friends and customers, stating the fact that The Ansonia Electric Company has established a World's Fair Bureau, and this is what they say: "To Our Customers and Friends.—Desiring to take advantage of the opportunity offered by the World's Fair to evidence our appreciation of favors in the past, received in such abundance from our customers and friends, and realizing that the demands of our business are such as to make it impossible for those actually engaged in its every day transactions to extend to our customers and friends such courtesies as we should be pleased to have them receive from us, we beg to announce that for this and other purposes in connection with the Great Exposition, we have organized a separate Department or World's Fair Bureau, and have concluded arrangements to place this department in charge of Hon. Geo. B. Shaw, who has been recently elected to Congress, and who is well known in electrical circles through his former connection with the National Electric Manufacturing Company, as its general manager. It will be a pleasure to us to hear from our friends and to render them any possible assistance either before or during their visit to the Fair. Trusting that we shall find that we may be of service to them we remain, very cordially, The Ansonia Electric Company, F. S. Terry, manager."

## Business Notices.

**Transformers** rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

**Oil Filters** for sale cheap. Prices on application to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

**Battery Cut-out, Cheap.**—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Meadville, Pa., March 18, 1893.

**W. J. Johnston Company, Ltd.:**

In a recent issue of your paper we notice an advertisement of A. L. Ide & Son, Springfield, Ill., which is somewhat misleading in the wording. It refers to some engines at Lincoln, Neb., which were erected by us early in 1891, and we are in receipt of a letter from Chas C. Upham, manager of the Lincoln Street Railway Company, dated April 26, 1892, stating that the "Dick & Church" engines in operation in the power house of that company for the past eight or ten months are giving all the satisfaction which could be asked for, and that although rated at 100 h. p. they were frequently called upon to develop as high as 150 h. p. during the busy hours of the day, and had carried these excessive loads without any apparent effect on the engines. In another letter, dated Feb. 10, 1893, Mr. Upham regrets that we could not make a better figure than that named by us on a proposed trade for larger engines, and inasmuch as we could not lower our prices they had made a trade with Ide & Son to furnish three of their engines of 250 h. p. capacity, disposing to them four of the small engines, retaining two, however, to drive smaller generators, instead of the M. P. 82-k. w. generators they had been coupled to.—Phœnix Iron Works Company.

# OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

## UNITED STATES PATENTS ISSUED MARCH 14, 1893.

In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

**493,089. Truck for Electric Locomotives;** John C. Henry, New York. Application field Dec. 18, 1891. The combination with the car wheels and axles of the truck-frame, the motor supported thereon and the shouldered cross-bar forming part of said frame and spreading the side bars thereof against the wheel hubs.

**493,243. Electric Switch;** Wm. Fr. Bossert, Utica, N. Y. Application filed Feb. 17, 1892. The combination of a switch disc, an operating lever having cam faces within an opening in the lever, a pin from the disc, projected into the opening of the lever and a spring connecting the lever and the disc. (See illustration.)

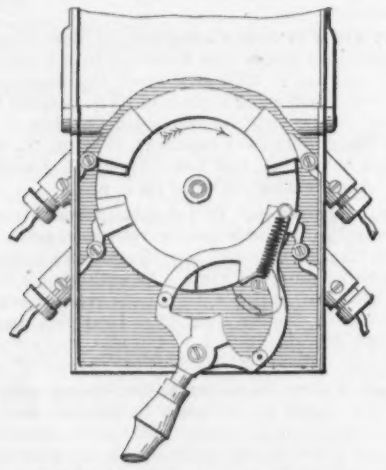
**493,245. Ear Attachment for Telephones;** George McClellan Brown, Nashville, Tenn. Application filed June 23, 1892. In a telephone attachment, the combination with a bifurcated extensible ear piece having a main flexible tube or branch of a telephone receiver, and a non-resonant flexible coupling between the tube and the receiver.

**493,253. Signaling Telegraph;** William E. Decrow, Boston, Mass. Application filed Nov. 14, 1892. In a signaling telegraph the combination with the main line of a second circuit extending to the central station a time, stamp included in the circuit, and means for momentarily operating the circuit at the signal box whenever it is pulled.

**493,297. Acoustic Telephone;** Thomas B. Rogers, Brooklyn, N. Y. Application filed June 3, 1892. An acoustic telephone having a diaphragm composed of a non-metallic front disc, a metallic supporting disc for it, and an elastic ring separating the discs at their edges.

**493,313. Dynamo Electric Machine;** Elihu Thomson Swampscott, Mass. Application filed July 28, 1891. This machine has a series of core sections, and coils wound on the alternate sections and extending close to the intervening sections.

**493,314. Lightning Arrester;** Elihu Thomson, Swampscott, Mass. Application filed Oct. 28, 1892. The combination of lightning arrester discharge terminals arranged to form a spark gap or gaps, with an arc thereat and means for limiting or reducing the current tending to follow the passage of the discharge to earth.



No. 493,243.—Electric Switch.

**493,328. Multiple Terminal Cut-Out;** Lark P. Bonebrake, Maryville, Mo. Application filed Nov. 10, 1892. A multiple terminal cut-out consisting of a series of contact levers pivoted on a circular line and held to position by a series of pins and fusible wires, the latter connecting with the main line in combination with a spring-actuated circuit closer pivoted concentric to the contact levers, and a spring on the end of the circuit closer.

**493,337. Armature for Dynamo Electric Machines;** Horace F. Parshall, Lynn, Mass. Application filed Sept. 15, 1892. This armature comprises an annular core, fitted to and surrounding an internal concentric support, and with keys between the support and the core, whereby any motion of one independently of the other is prevented. (See illustration.)

**493,346. Personal Equation Chronograph;** L. De Lauter Wells, London, England. Application filed June 17, 1892. In an electric chronograph, the combination of an electro-magnetically operated tuning fork, a stylus carried thereby, a rotary record drum fixed upon a shaft and provided with guides and a projection, means for rotating the drum, and a spring-top adapted to automatically arrest the motion of the drum.

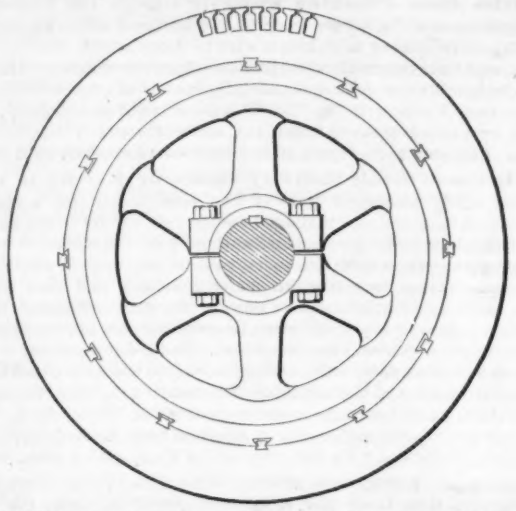
**493,349. Armature for Motors and Generators;** Norman C. Bassett, Lynn, Mass. Application filed July 9, 1891. The combination of a laminated core, the shaft, and spiders having heads embracing the core between them, and cylindrical flanges engaging with the interior of the core and of such dimensions as to form a support for substantially all the laminæ of the core.

**493,358. Electric Search Light;** R. M. Hunter, Philadelphia. Application filed June 17, 1892. The combination of a frame, an electric lamp carried by same, a reflector secured to this frame by means of springs disposed in a transverse plane through the focal point, and mechanical means to vibrate the reflector vertically.

**493,359. Electric Arc Lamp;** Rudolph M. Hunter, Philadelphia, Pa. Application filed Oct. 14, 1892. The combination of two carbon holders, a device to feed one carbon holder toward the other, a regulator for controlling the feeding device arranged independently of and laterally with respect to the carbon holders, and a connecting wire of considerable length arranged between the regulator and the feeding mechanism whereby the regulator and feeding device of the lamp may be widely separated. (See illustration.)

**493,361. Switch for Electric Motors;** Moritz Immisch, London, Eng. Application filed Nov. 21, 1891. In combination with the make and brake lever switch levers and locking devices for preventing adjustment of the switch levers under certain conditions as specified, of a stop in the path of the make and brake lever and a resistance lever adapted to engage the stop.

**493,369. Electric Switch;** Alfred Stromberg, Chicago, Ill. Application filed Nov. 1, 1892. The combination with contact springs normally resting against their contact points and situated at the rear of the board, a shaft passing through the board and carrying at its front end a handle, a cam mounted on the shaft between these springs and of a length greater than the semi-distance between the springs, this shaft being adapted to rotate



No. 493,337.—Armature for Dynamo Electric Machines.

in either direction to lift one or the other of the springs from its contact, the end of the cam being adapted to fit the springs to hold the shaft in its new position, whereby the position of the handle may indicate the condition of the line as to electrical connection.

**493,375. Balanced Armature for Dynamo Electric Machines or Electric Motors and Method of Balancing Same;** Gano S. Dunn, New York, N. Y. Application filed June 6, 1892. An armature core provided with one or more openings extending substantially parallel with the sustaining shaft, in combination with one or more balancing masses located therein. (See illustration.)

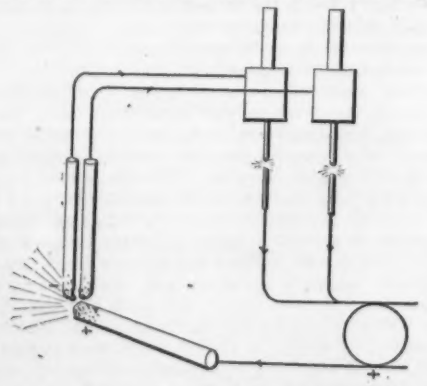
**493,380. Combined Cut-Out and Lightning Arrester;** Ernst F. Hammarstrom, Stockholm, Sweden. Application filed June 3, 1892. An improved electric cut-out, comprising in combination the main line wire bearing; the expansible open ring or bow spring attached at a convenient point between its ends to said bearing; the spring latch attached to the other line wire bearing and adapted to be engaged with the ends of the ring to close the circuit, said circuit being broken through the expansion of said ring and release of the spring latch by the electric current.

**493,411. Base for Electric Light Brackets;** James T Robb, Mount Vernon, N. Y. Application filed Feb. 24, 1891. The combination with an electric light bracket or fixture, of a base cover consisting of a cup-shaped section, a segment of which is cut away, a second cup-shaped section fitting the first and having a similar segment cut away, both sections surrounding the base of the bracket or fixture and one being movable whereby the openings may be brought into or out of line with each other.

**493,423. Safety Device for Elevator Shafts;** Albert D. Caywood, Chicago, Ill. Application filed Aug. 29, 1892. An arrester comprising a chain adapted to be connected at one end with the controlling mechanism of the elevator, and carrying at its opposite end a weight, pivotally connected gripper jaws normally held by the lock in closed condition and sustaining the weight-carrying chain, and means for actuating the gripper mechanism to disengage the chain when the mechanism is released by the lock.

**493,425. Electric Locomotive;** Thomas A. Edison, Llewellyn Park, N. J. Application filed Jan. 19, 1891. The combination of a vehicle, a motor, a shaft for the motor having one or more pulleys, a shield for each of said pulleys and a connection between the shield and the vehicle for supporting the motor.

**493,431. Electric Motor for Dental Work;** Jeremiah Keller, Canton, O. Application filed June 6, 1892. In an electric motor, the combination of a bracket in two sections hinged together and provided with means for pivotally securing it to a wall, an electric motor mounted upon the inner end of said bracket with its armature shaft in line therewith, and provided with a pulley, two pulleys mounted at the pivotal connection of the sections of the bracket and revolving together horizontally,



No. 493,359.—Electric Arc Lamp.

a rope transmission between one of said pulleys and the pulley on the armature shaft, passing over two pulleys journaled on the inner end of the bracket and revolving independent of each other, and a rope transmission from the other end of said pulleys to the pulley mounted upon the inner end of the bracket and passing around two pulleys mounted at the outer end of the bracket and revolving independent of each other.

**493,434. Insulator Pin;** Fred M. Locke, Victor, N. Y. Application filed Sept. 29, 1892. An insulator pin comprising a hollow base, and a threaded or corrugated insulated sleeve mounted thereon, and a bolt for securing them together and to the cross arm.

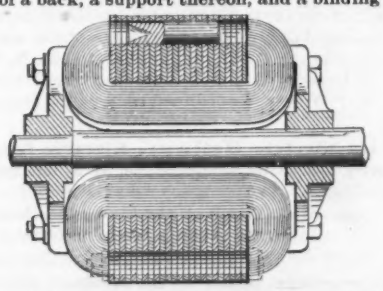
**493,439. Commutator for Dynamo Electric Machines and Method of Constructing the Same;** Alexander W. Weston, St. Louis, Mo. Application filed Sept. 12, 1892. As a new article of manufacture, a commutator for dynamo electric machines, consisting in the combination with a disc or annular supporting plate, provided with an annular groove on one side face of the same, and a radially extending circumferential lip portion, of a segmental contact ring secured in the said contact groove and insulated from the supporting plate.

**493,447. Armature Connection for Dynamo Electric Machines;** George A. Rollins, Chicago, Ill. Application filed Feb. 16, 1892. In a dynamo electric machine, the combination of an armature with coils and wires which are led off therefrom to commutator segment strips, each of said wires sharply bent into a curve at some point along its course from the armature to the strip, said bend being away from the general course of such wire in passing from armature to strip.

**493,485. Electric Switch;** Andrew M. Coyle, Baltimore, Md Application filed March 3, 1892. An electric switch mechanism comprising in combination a slide carrying brushes connected respectively with the two conductors of the supply or main circuit, a slideway in which said slide is adapted to move, a series of resistances, a series of terminal plates in said slideway on the side opposite to the first and connected each with one of the series, the two series being separated by a space of greater length than said slide, so that as said slide is moved from its intermediate position in either direction it completes the main circuit first through all the resistances and cuts these out one by one as it approaches the extremity of its path.

**493,558. Telethermometer;** L. S. Norton and F E. Hoffman, Alpena, Mich. Application filed Oct. 31, 1892. A series of compartments, each provided with a thermometer having a series of contact points corresponding with different degrees of temperature; an indicator provided with a series of signals corresponding with the respective contact points of the thermometers; electrical conductors connecting the respective contact points of the thermometers with the corresponding signals of the indicator; a source of electrical energy, and a series of circuit closing keys or devices arranged to complete the circuit between the contact points of the thermometers and the indicator signals at will.

**493,601. Thermostat;** Thomas W. Shepherd, Peabody, Mass. Application filed Aug. 6, 1891. In a thermostat, the combination of a back, a support thereon, and a binding post secured



No. 493,375.—Balanced Armature for Dynamo Electric Machines or Electric Motors and Method of Balancing Same.

to said support, a contact screw extended transversely through said binding post, a nut of insulating material on said screw to prevent the latter coming in contact with said back, a lamina and a contact arm moved thereby.

**493,602. Electric Controlling Device;** Thomas W. Shepherd, Peabody, Mass. Application filed Oct. 24, 1891. The combination of a movable main contact arm, main contacts between which it moves, a movable main contact arm, an auxiliary contact arm connected therewith by a flexible connection and auxiliary contacts independent of said main contacts between which said auxiliary arm moves.

**493,609. Lamp Socket;** Henry P. Ball and Amandus Metzger, Schenectady, N. Y. Application filed Aug. 3, 1892 The combination of a socket body, a spiral wire sleeve secured to a metal cup or ring, having an outwardly extending flange to which the sleeve is secured, means for securing said cup or ring to said socket body and a central socket contact device.

**493,618. Electric Railway Conduit and Contact;** Joel Davis and Reuben M. Huntington, Denver, Colo. Application filed Oct. 2, 1891. In an electrical railroad system, the combination of the underground conduit having the two part insulating blocks recessed to receive the walls of the conduit, a block being located on each side, bolts passing through said blocks, the longitudinally divided conductor having its parts attached to the extremities of the bolts but insulated therefrom, the gatherer carried by the car, and provided at its lower extremity with a slotted plate, movable spring, actuated boxes located in said slots and carrying rotable discs engaging the side conductors, from which the current passes to the motor on the car through the medium of the discs, journal boxes and conducting plate of the gatherer.

**493,620. Telegraph Relay;** Samuel P. Frier, East Orange N. J. Application filed Dec. 15, 1891. In a duplex or quadruplex telegraph system, a relay which is responsive to changes in current strength, consisting of three coils, all included in a single circuit, one for polarizing the armature of said relay, and the other two under the influence of the same current, serving mutually to attract or repel said armature or armatures.

**493,623. Electric Railway System;** Thomas Harris, Detroit, Mich. Application filed Jan. 8, 1892. The combination of a continuous power line, a discontinuous working conductor, a contact on the car to connect the ends of adjacent sections of said working conductor, a switch line forming in connection with the power line, a switch circuit and switching devices connected to the sections of the working conductor and operated by said switch circuit, said switching devices comprising an electro-magnet with two opposing helices, one to close the contacts controlled by the armature of the magnet and the other to open said contacts again by neutralizing the magnet when the car has passed to the adjacent section of the working conductor.

*Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y*